J. A. HENDERSON'S

INTELLECTUAL AND PRACTICAL

Lightning Calculator.

CORRECTED, REVISED,

AND SUPPLEMENTED BY IMPORTANT RULES IN

FRENCH, SPANISH AND GERMAN.

SECOND EDITION.

SAN FRANCISCO.

1873.

HENDERSON'S

Intellectual and Practical

LIGHTNING CALCULATOR.

BY

J. A. HENDERSON,

GRADUATE OF UNION COLLEGE.

Author of Calculator, Book of Blocks Illustrating Roots, and the New Decimal Method of Computing Interest and Imparting the same.

ALL ORDERS ADDRESSED TO

J. A. HENDERSON,

SAN FRANCISCO.

70313

PREFACE.

It is better to know everything about something, than something about everything.

Early ideas are not usually true ideas, but need to be revised and re-revised. Right means straight, and wrong means crooked. And knowing that thought kindles at the fire of thought, we do not hesitate to offer any apology for presenting to the public some new seed-thoughts, and right methods of operation in business calculations.

The practical utility of this book consists in the brevity, conciseness, and general application of its rules. Particular attention is invited to the grand improvements in computing time, all possible cases in interest, squaring and multiplying numbers, dividing and multiplying fractions, an infinite number of ways and the absolute right method of extracting roots.

TABLE OF CONTENTS.

THE LIGHTNING CALCULATOR.

The arithmetical alphabet, as written and read,

	one one,	two ones,	three ones	four ones,	five ones,	six ones,	seven ones,	eight ones,	nine ones,	
is	$\frac{1}{1}$,	$\frac{2}{1}$,	$\frac{3}{1}$,	$\frac{4}{1}$,	$\frac{5}{1}$,	$\frac{6}{1}$,	$\frac{7}{1}$,	$\frac{8}{1}$,	$\frac{9}{1}$ &	$\frac{0}{1}$.

The second is two times the first; the third three times the first, etc., up to the last. All numbers larger than nine are expressed by combining two or more of these ten letters or figures, and assigning different values to them, according as they occupy different places.

Ten is expressed by combining one and zero, thus, 10; and omitting the unity or denominator for brevity; two and zero combined make twenty, thus, 20; three and zero, thus, 30, etc. A hundred is expressed by combining the one and two zeros, thus, 100; two hundred, thus, 200. Ten ones make a ten; ten tens make a hundred; ten hundred make one thousand; that is, numbers increase from right to left in a tenfold ratio; hence each removal of a figure one place towards the left increases its value ten times.

The different values which the same figures have are called simple and local values. The simple value of a figure is the value which it expresses when it stands alone, or in the right hand place.

The local value of a figure is the increased value which it expresses by having other figures placed on its right.

NUMERATION.

The art of reading numbers when expressed by figures is called numeration, and can be easily acquired from the following table:

Tredecillions.	Duodecillions.	Undecillions.	Decillions.	Nonillions.	Octillions.	Septillions.	Sextillions.	Quintillions.	Quadrillions	Trillions.	Billions.	Millions.	Thousands.	Units.
685	678	398	746	391	872	281	964	358	123	243	795	937	456	144
XV	XIV	XIII	XII	XI	X	IX	VIII	VII	VI	V	IV	III	II	I

We have here fifteen periods of three figures each, beginning at the right hand. The *first* period, which is occupied by units, tens, hundreds, is called *units* period; the second is occupied by thousands, tens of thousands, hundreds of thousands, and is called thousands period; and so on, the orders of each successive period being *units*, *tens* and *hundreds*.

The figures in the table are read thus: 685

tredecillions, 678 duodecillions, 398 undecillions, 746 decillions, 391 nonillions, 872 octillions, 281 septillions, 964 sextillions, 358 quintillions, 123 quadrillions, 243 trillions, 795 billions, 937 millions, 456 thousands, 144 units or ones.

To read numbers expressed by figures: Point them off into periods of three figures each, commencing at the right hand; then, beginning at the left hand, read the figures of each period in the same manner as those of the right hand figure are read, and at the end of each period pronounce its name.

The method of acquiring the multiplication table is of great importance, and is represented thus:

$$\frac{1}{1} \quad \frac{2}{1} \quad \frac{3}{1} \quad \frac{4}{1} \quad \frac{5}{1} \quad \frac{6}{1} \quad \frac{7}{1} \quad \frac{8}{1} \quad \frac{9}{1}$$

Forms the first line of the multiplication table, and may be rehearsed thus: 1 times 1 is 1; 2 times 1 is 2; 3 times 1 is 3; 4 times 1 is 4; 5 times 1 is 5; 6 times 1 is 6; 7 times 1 is 7; 8 times 1 is 8; 9 times 1 is 9.

The second line is 2 times the first, thus:

2 times 1 is 2.
2 times 2 is 2 more than 2, or 4.
2 times 3 is 2 more than 4, or 6.
2 times 4 is 2 more than 6, or 8.
2 times 5 is 2 more than 8, or 10.
2 times 6 is 2 more than 10, or 12
2 times 7 is 2 more than 12, or 14.

2 times 8 is 2 less than 18, or 16.
2 times 7 is 2 less than 16, or 14.
2 times 6 is 2 less than 14, or 12.
2 times 5 is 2 less than 12, or 10.
2 times 4 is 2 less than 10, or 8.
2 times 3 is 2 less than 8, or 6.
2 times 2 is 2 less than 6, or 4.

Thus gaining a knowledge of addition and subtraction, and in fixing in the understanding a knowledge of the table.

The third line is three times the first.
The fourth line is four times the first.
The fifth line is five times the first.
The sixth line is six times the first.
The seventh line is seven times the first, etc.

ADDITION.

$$\begin{array}{l} 3 \\ 2 \\ 5 \\ 7 \\ 6 \; {}_2 \\ 4 \\ 8 \\ 9 \\ 3 \\ 2 \\ 4 \\ 6 \\ \hline 59 \end{array}$$

Commence at the units column, add two figures at once, omitting the words *and* and *are,* stopping between forty and fifty. Thus: 10, 15, 32, 42, writing the 2 at the right of the 6; begin again—12, 17, 19, writing down the 9; carry 1 for the 19 and 4 for the catch figure, making 59.

46
53) Two or more columns may be added in
747) 3 a similar way
98)
76 RULE.—*For adding one or more columns,*
34) *commence at the right hand column; find the*
62 *sum; add all except the right hand figure to*
47) *the second column; proceed in like manner*
56 *with all the remaining columns.*
—
519

THE LIGHTNING PROCESS BY COMBINATION.

First four rows are miscellaneous; second four are the complement of the first, taking 9 as the base:

```
 763712367
 812367842
 176542051
 534256729
 236287632
 187632157
 823457948
 465743270
 ---------
4579831022
        18
```

RULE.—*Prefix the number of nines to the odd row, strike a line and subtract the number of nines.*

MULTIPLICATION.

To find the product of two numbers, when the multiplicand and the multiplier each contain but two figures.

EXAMPLE 1.—

$$\begin{array}{r} 32 \\ 21 \\ \hline 672 \end{array}$$

EXPLANATION.—1. Multiply the units of the multiplicand by the unit figure of the multiplier. Thus: 2×1 is 2: Set the 2 down; multiply the tens in the multiplicand by the unit figure in the multiplier, and the units in the multiplicand by the tens figure in the multiplier, thus: 1×3 is 3; and 2×2 are 4; add these two products together, $3+4$ are 7. Set down the 7; multiply the tens in the multiplicand by the tens in the multiplier, thus: 2×3 are 6, the whole amount, 672.

USEFUL CONTRACTIONS.

To multiply two figures by 11.

RULE.—*Between the two figures write their sum, thus:*

$$\begin{array}{r} 32 \\ 11 \\ \hline 352 \end{array}$$

Thus: the sum of 3 and 2 are 5; place the 5 between the 3 and 2 for the product.

$$\begin{array}{r} 34 \\ 11 \\ \hline 374 \end{array}$$

When the sum of two figures is over 9, increase the left hand figure by 1.

$$\begin{array}{r} 78 \\ 11 \\ \hline 858 \end{array}$$

Three ones multiplied by three ones are 12321; four ones by four ones are 1234321; five ones by five ones are 123454321, etc., etc.

To multiply any number of nines by the same number of nines, thus: 9999999×9999999 are 99999980000001. Or, the square of any number of nines is as many nines as are in the number minus one, eight and as many ciphers as nines, and one.

To Square any Number Ending in Five.

Rule.—*Omit the five and multiply the number by the next higher number, and annex twenty-five to the product.*

What is the square 85? Ans. 7225.

Explanation: We simply omit the 5, and multiply the 8 by 9, the next higher number, and annex 25.

The square of 25 is 625.
The square of 35 is 1225.

The square of 45 is 2025
The square of 65 is 4225
The square of 75 is 5625 etc.

For multiplying mixed numbers: $2\frac{1}{2}$ by $2\frac{1}{2}$ is $6\frac{1}{4}$—increase 2 by 1 and multiply by 2, and annex the product of $\frac{1}{2}$ by $\frac{1}{2}$, increase 2 by 1, since the sum of the fractional parts is a unit.

$2\frac{1}{4}$ by $2\frac{3}{4}$ is $6\frac{3}{16}$
$2\frac{1}{5}$ by $2\frac{4}{5}$ is $6\frac{4}{25}$
by $4\frac{1}{3}$ is $20\frac{2}{9}$
by $5\frac{1}{3}$ is $30\frac{2}{9}$
by $6\frac{2}{3}$ is $42\frac{2}{9}$
by $1\frac{6}{7}$ is $2\frac{6}{49}$
by $2\frac{6}{7}$ is $6\frac{6}{49}$
by $3\frac{6}{7}$ is 12^{6}
by $4\frac{6}{7}$ is $20\frac{6}{49}$
by $5\frac{1}{7}$ is $30\frac{6}{49}$
by $6\frac{1}{7}$ is 42_{49}

RULE.—*The integer increase by one; multiply by the integer, and the product of the fractional parts annex; increase the integer by one since the sum of the fractional parts make a unit.*

RAPID PROCESS OF MARKING GOODS.

To tell what an article should retail for to make a profit of 20 per cent., is done by removing the decimal point one place to the left.

For instance, if hats cost \$17.50 per dozen, remove the decimal point one place to the left,

making \$1.75—what they should be sold for apiece to gain 20 per cent. on the cost. If they cost \$13 per dozen, they should be sold for \$1.30 apiece, etc.

RULE.—*Remove the point one place to the left, on the cost per dozen, to gain* 20 *per cent.; increase or diminish to suit the required rate.*

NOTE.—*Remove the point one place to the left, for* 12 *tens make* 120.

TABLE

For marking all articles bought by the aozen.

N. B. Most of these are used in business. To make 20 per cent., remove the point one place to the left.

To make	80	per cent.	remove the	point and	add	one	half	itself.
"	60	"	"	"	"	"	third	"
"	50	"	"	"	"	"	fourth	"
"	44	"	"	"	"	"	fifth	"
"	40	"	"	"	"	"	sixth	"
"	37 1/7	"	"	"	"	"	seventh	"
"	35	"	"	"	"	"	eighth	"
"	33 1/4	"	"	"	"	"	ninth	"
"	32	"	"	"	"	"	tenth	"
"	30	"	"	"	"	"	twelfth	"
"	28	"	"	"	"	"	fifteenth	itself.
"	26	"	"	"	"	"	twentieth	"
"	25	"	"	"	"	"	twenty-fourth	"
"	12 1/2	"	"	"	subtract one sixteenth			"
"	16 2/3	"	"	"	"	"		"
"	18 3/4	"	"	"	"	"	twenty-sixth	"

If you buy one dozen shirts for \$28, what shall I retail them for to make 50 per cent.? Ans. \$3.50.

TABLE

Of the Aliquot parts of 100 *and* 1000.

N. B. Most of these are used in business.

$12\frac{1}{2}$	is $\frac{1}{8}$ part of	100	$8\frac{1}{3}$	is 1-12 part of	100
25	is 2-8 or $\frac{1}{4}$ of	100	$16\frac{2}{3}$	is 2-12 or 1-6 of	100
$37\frac{1}{2}$	is 3-8 part of	100	$33\frac{1}{3}$	is 4-12 or $\frac{1}{3}$ of	100
50	is 4-8 or $\frac{1}{2}$ of	100	$66\frac{2}{3}$	is 8-12 or $\frac{2}{3}$ of	100
$62\frac{1}{2}$	is $\frac{5}{8}$ part of	100	$83\frac{1}{3}$	is 10-12 or 5-6 of	100
75	is 6-8 or $\frac{3}{4}$ of	100	125	is $\frac{1}{8}$ part of	1000
$87\frac{1}{2}$	is 7-8 part of	100	250	is 2-8 or $\frac{1}{4}$ of	1000
$6\frac{1}{4}$	is 1-16 part of	100	375	is $\frac{3}{8}$ part of	1000
$18\frac{3}{4}$	is 3-16 part of	100	625	is $\frac{5}{8}$ part of	1000
$31\frac{1}{4}$	is 5-16 part of	100	875	is $\frac{7}{8}$ part of	1000

To multiply by an aliquot part of 100.

RULE.—*Take such a part of the multiplicand as the multiplier is part of* 100, *and call it hundreds.*

To multiply by an aliquot part of 1000: Tako such part of the multiplicand as the multiplier if part of 1000, and call it thousands.

To divide by the aliquot parts of 100.

To divide any number by $12\frac{1}{2}$: remove the point two places to the left, and multiply the quotient by 8. Multiply the quotient by 8, because $12\frac{1}{2}$ is $\frac{1}{8}$ of 100.

To divide any number by 25: remove the point two places to the left, and multiply by 4.

$$\begin{array}{lr} & 345 \div 25 \\ & 3.45 \\ & 4 \\ \hline \text{Ans.} & 13.80 \end{array}$$

To divide any number by 50: remove the point two places to the left and multiply by 2.

$$\begin{array}{r} .75 \div 50 \\ 2 \\ \hline 1.50 \end{array}$$

To divide any number by 75: remove the point two places to the left, multiply by 4 and divide by 3; because 75 is $\frac{3}{4}$ of 100.

To divide by the aliquot parts of 1000.

To divide any number by 125: remove the point three places to the left and multiply by 8. Remove the point three places to the left to divide by a thousand and multiply by 8; because 125 is $\frac{1}{8}$ of a thousand.

Thus: $\begin{array}{r} 3467 \div 125 \\ 8 \\ \hline 27.736 \end{array}$ Ans. 27.736

$\begin{array}{r} 9.712.29 \div 125 \\ 8 \\ \hline 77.69832 \end{array}$ Ans. 77.69832

Etc., for all other examples.

To divide any number by 250: remove the point three places to the left and multiply by 4.

$$\begin{array}{r} 4.357 \div 250 \\ 4 \\ \hline 17.428 \end{array}$$

Ans. 17.428

$$\begin{array}{r} 357.25 \div 250 \\ 4 \\ \hline 1.42900 \end{array}$$

Ans. 1.42900

HENDERSON'S LIGHTNING PROCESS OF CALCULATING INTEREST.

The base of our system of notation being 10, numbers increase and diminish in a tenfold ratio; increasing from the decimal point to the left, and decreasing from the decimal point towards the right. Hence, to divide any number by 10, remove the point one place to the left.

To divide any number by 100, remove the point two places to the left.

To divide any number by 1000, remove the point three places to the left.

To multiply any number by 10, remove the point one place to the right.

To multiply any number by 100, remove the point two places to the right.

To multiply any number by 1000, remove the point three places to the right.

INTEREST.

Since the interest is generally a part of the principal, the method of calculating it, will come under the method of dividing. The rule establishes the time when a dollar makes a cent, and we remove the point two places to the left; for one hundredth of the principal equals the interest. In ten times that time, a dollar makes ten cents. and we remove the point

one place to the left, because a tenth of the principal is the interest; in one tenth of the same time a dollar makes a mill, and we remove the point three places to the left, because one thousandth of the principal equals the interest.

RULE.—*The reciprocal of the rate, or the rate inverted, indicates the time when the decimal point can be removed two places to the left in all cases; ten times that time one place to the left, and one tenth of the same time three places to the left. Increase or diminish the results to suit the time given.*

The arithmetical alphabet is $\frac{1}{1}$, $\frac{2}{1}$, $\frac{3}{1}$, $\frac{4}{1}$, $\frac{5}{1}$, $\frac{6}{1}$, $\frac{7}{1}$, $\frac{8}{1}$, $\frac{9}{1}$, and 0; $\frac{1}{1}$ inverted is 1; $\frac{2}{1}$ inverted is $\frac{1}{2}$; $\frac{3}{1}$ inverted is $\frac{1}{3}$, etc. If the rate is 1 per cent. per month, one inverted gives the time when a dollar makes a cent, and the point removed two places to left, shows the interest in every case.

Ten times one inverted, or ten months, a dollar makes ten cents, and the point being removed one place to the left, all examples for that rate and time are calculated. One tenth of one month, or three days, a dollar makes a mill, and the point removed three places to the left, shows the interest in all examples for that rate and time. We remove the point one place to the left, because a tenth of the principal is the interest. We remove the point two places, because a hundredth of the principal is the interest. We remove the point three places, because a thou-

sandth of the principal is the interest. To reach all other time, simply increase or diminish the results to suit the time given.

$600.00 @ 1 per cent. per mo. for two months, remove the point two places to the left = $6.00 the interest for one month. Twice $6.00, the interest for one month, is $12.00, the interest for two months. The interest on the same amount for three days is .60 cts., simply removing the point three places to the left. The interest for ten months on the same amount, would be $60.00. Simply removing the point one place to the left, $60.00, the interest for ten months, plus $12,00, the interest for two months is $72.00, the interest for one year.

By this method we can calculate an infinite number of examples in a moment when working from the base. At one per cent. per month:

	Int. 3 days.	Int. one month.	Int. 10 months.	
Thus.	$2	5	6	7.35
		8	6	1.50
	9,	7	4	6.75
	11,	4	6	3.25
	22,	5	3	8.40
	1,	0	0	0.50

By this method a world of work is done in the twinkling of an eye, and the way opened to the answer of every example in interest.

The rate is 2 per cent. per month, 2 inverted is $\frac{1}{2}$, or 15 days, the point removed two places to the left, all examples are calculated for that rate and date, 10 times half a month or five months, the point removed one place to the left, all examples are calculated. One tenth of 15 days, or a day and a half, the point removed three places to the left, all examples are performed for that time and rate.

1½ days int. at 2 per cent. per month.	15 days int. at 2 per cent. per month.	5 months int. at 2 per cent. per month	
$10,	0	0	0.50
25,	6	5	0.00
2,	4	7	5.30
9,	4	6	0.50
	2	5	0.31

Simply increasing or diminishing the results we find the answer for any other time.

PROBLEMS IN INTEREST.

PROBLEM 1.—What is the interest of $50 for 4 years at 6 per cent.

SOLUTION.—Removing the point one place to the left, we have $5.00 the interest for 20 months. For 40 months, it is $10.00; 8 months, being the fifth of 40 months, the interest would be $2.00; $10.00 plus $2.00 is $12.00 the interest for 48 months, or 4 years.

PROBLEM 2.—What is the interest of $10.00 for 2 years, at 5 per cent? Simply remove the point one place to left, and you have the interest.

PROBLEM 3.—What is the interest of $48.00 for 6 years, at 5 per cent.?

PROBLEM 4.—What is the interest of $70.00 for 7 years, at 5 per cent.?

PROBLEM 5.—What is the interest of $68.00 for 5 years, at 6 per cent.?

PROBLEM 6.—What is the interest of $70.00 for 2 years, at 5 per cent.?

PROBLEM 7.—What is the interest of $75.00 for 5 years, at 3 per cent.?

PROBLEM 8.—What is the interest of $120.00 for 8 years, at 5 per cent.?

PROBLEM 9.—What is the interest of $100.00 for 10 years, at 6 per cent.?

PROBLEM 10.—What is the interest of $140.00 for 12 years, at 5 per cent.?

PROBLEM 11.—What is the interest of $150.00 for 5 years, at 3 per cent.?

PROBLEM 12.—What is the interest of $145.00 for 6 years, at 5 per cent.?

PROBLEM 13.—What is the interest of $200.00 for 10 years, at 8 per cent.?

PROBLEM 14.—What is the interest of $250.00 for 3 years, at 8 per cent.?

PROBLEM 15.—What is the interest of $500.00 for 9 years, at 8 per cent.?

PROBLEM 16.—What is the interest of $50.00 for 2 years and 2 months, at 2 per cent.?

PROBLEM 17.—What is the interest of $80.00 for 8 years and 6 months, at 6 per cent.?

PROBLEM 18.—What is the interest of $90.00 for 5 years and 6 months, at 6 per cent.?

SOLUTION.—Remove the point one place to the left, we have $9.00 the interest for 20 months. The interest would be 3 times $9.00, which is $27.00 for 5 years. The interest for 6 months would be one tenth of $27.00, which is $2.70, which added to $27.00, makes $29.70, Ans.

PROBLEM 19.—What is the interest of $90.00 for 12 years and 10 months, at 6 per cent.?

PROBLEM 20.—What is the interest of $200.00 for 4 years and 8 months, at 3 per cent.?

PROBLEM 21.—What is the interest of $70.00 for 8 years and 4 months, at 2 per cent.?

PROBLEM 22.—What is the interest of $225.00 for 52 days, at 7 per cent.? Ans. $2.25.

PROBLEM 23.—What is the interest of \$500.00 for 26 days, at 7 per cent.? Ans. \$2.50.

PROBLEM 24.—What is the interest of \$500.00 for 2 years, 6 months, and 15 days, at 4 per cent.?

SOLUTION.—Remove the point one place to the left we have \$50.00, the interest for 2 years and 6 months. Removing the point two places to the left, we have \$5.00 the interest for 3 months; 15 days being one sixth of three months, we have 83⅓ cts. the interest for 15 days, which added to \$50.00 makes \$50.83⅓, Ans.

PROBLEM 25.—What is the interest of \$200.00 for 5 years, 9 months and 18 days, at 5 per cent.?

SOLUTION.—Removing the point one place to the left we have \$20.00, the interest for 2 years. The interest for 5 years would be 2½ times \$20.00, or \$50.00. The interest for 1 year is \$10.00; for 9 months it would be ¾ of \$10.00, which is \$7.50. Removing the point 2 places to the left, we have \$2.00, the interest for 72 days, the interest for 18 days would be the fourth of \$2.00, which is 50 cents, added to \$57.50, would be \$58.00, Ans.

PROBLEM 26.—What is the interest of \$700.00 for 1 year, 7 months, and 18 days, at 6 per cent.?

PROBLEM 27.—What is the interest of \$250.00 for 3 months, at 1 per cent. per month?

SOLUTION.—Remove the point two places to left, we have \$2.50, the interest for one month.

The interest for 3 months would be three times $2.50, which is $7.50, Ans.

PROBLEM 28.—What is the interest of $60.00 for 6 years. 4 months, and 24 days, at 5 per cent.?

PROBLEM 29.—What is the interest of $40.00 for 1 year, at 1 per cent. per month?

PROBLEM 30.—What is the interest of $950.25 for 9 months, at 1 per cent. per month?

PROBLEM 31.—What is the interest of $55.00 for 11 months, at 1 per cent. per month?

PROBLEM 32.—What is the interest of $200.00 for 10 months, at 1 per cent. per month?

PROBLEM 33.—What is the interest of $144.50 for 15 months, at 1 per cent. per month?

PROBLEM 34.—What is the interest of $60.00 for 22 months, al 1 per cent. per month?

PROBLEM 35.—What is lhe interest of $600.00 for 18 days, at 10 per cent. per ennum?

SOLUTION.—Remove the point two places to the left, we have $6.00, the interest for 36 days. The interest for 18 days is one-half of $6.00, which is $3.00, Ans.

PROBLEM 36.—What is the interest of $250.25 for 35 days, at 10 per cent. per annum?

PROBLEM 37.—What is the interest of $360.50 for 1 year, at 10 per cent. per annum? $36.05, Ans.

PROBLEM 38.—What is the interest of $200.00 for 72 days, at 10 per cent. per annum?

Problem 39.—What is the interest of \$80.00 for one year, at $\frac{5}{6}$ per cent. per month? Ans. \$8.00.

Problem 40.—What is the interest of \$500.00 for 2 years, at $\frac{5}{6}$ per cent. per month?

Problem 41.—What is the interest of \$250.00 for 3 years, at $\frac{5}{6}$ per cent. per month?

Note.—Remove the point one place to the left, because a tenth of the principal is the interest. Two places, because a hundredth of the principal is the interest, etc.

Problem 52.—What is the interest of \$250.00 for one month, at 1 per cent. per month?

Solution.—At 1 per cent. per month, one one hundredth of the principal is the interest, we therefore remove the point two places to the left. Ans. \$2.50. Removing the point two places to the left, we have the answer.

Problem 43.—What is the interest of \$250.50 for 2 months, at 1 per cent. per month?

Solution.—Removing the point two places, we get the interest \$2.505 for 1 month; for 2 months, the interest would be twice \$2.505, which would be \$5.01.

Problem 44.—What is the interest of \$100.00 for 15 days, at 1 per cent. per month?

Solution.—Removing the point two places to the left, we get the interest \$1.00, for 1 month. The interest for 15 days would be one half of \$1.00, or 50 cents.

PROBLEM 45.—What is the interest of $145.00 for 3 days, at 1 per cent. per month?

SOLUTION.—Remove the point three places to the left, and we have $1.45, Ans.

PROBLEM 46.—What is the interest of $2000.00 for 9 days, at 1 per cent. per month?

SOLUTION.—Remove the point three places, we have the interest $2.00 for 3 days; for 9 days, $6.00, Ans.

PROBLEM 47.—What is the interest of $250.25 for 12 days, at 1 per cent. per month?

PROBLEM 48.—What is the interest of $270.00 for 10 months, at 1 per cent. per month? Remove the point 1 place to the left. Ans. $27.00.

PROBLEM 49.—What is the interest of $350.00 for 1 year, at 1 per cent. per month? Remove the point one place, we have the interest $35.00 for 10 months, for one year, one fifth more, $42.00, Ans.

PROBLEM 50.—What is the interest of $250.00 for 11 months and 3 days, at 1 per cent. per month? Interest 10 months, $25.00; interest 1 month, $2.50; interest 3 days, 25 cents, equals $27.75, Ans.

PROBLEM 51.—What is the interest of $2,500.00 for 1 year, at 1 per cent. per month?

PROBLEM 52.—What is the interest of $125.00 for 33 days, at 1 per cent. per month?

PROBLEM 53.—What is the interest of $260.00 for 24 days, at 1¼ per cent. per month?

Solution.—Remove the point two places to the left, we have the interest $2.60, Ans.

Problem 54.—What is the interest of $360.00 for 1 month, at 1¼ per cent. per month ?

Solution.—Remove the point two places to he left, we have $3.60, the interest for 24 days; add ¼, .90, we have $4.50, Ans.

Problem 55.—What is the interest of $800.50 for 8 months, at 1¼ per cent. per month ?

Solution.—Remove the point one place to the left. Ans. $80.05.

Problem 56.—What is the interest of $500.00 for 1 year, at 1¼ per cent. per month ?

Solution.—Remove the point one place to the left, we have the interest $50.00 for 8 months. For 4 months, the interest would be $25.00, added to $50.00, equals $75.00, Ans.

Problem 57.—What is the interest of $900.00 for 4 months, at 1¼ per cent. per month?

Solution.—Remove the point one place to the left, we have $90.00, the interest for 8 months; for 4 months, the interest would be one half of $90.00, or $45.00, Ans.

Removing the point one place to the left, gives the interest of any sum for 8 months, at 1¼ per cent., increase or diminish the result to suit the time given

METHOD OF SQUARING NUMBERS BY THEIR COMPLEMENT AND SUPPLEMENT.

The complement of a number is the difference between the number and some particular number above it.

The supplement of a number is the difference of a number and some number below it.

$(99)^2 = 9801$. Take the complement of 99 from it, call it hundreds, and add the square of the complement.

EXPLANATION.—Let N equal 99, and C equals 1. Then N plus C $= 100$. N—C $= 98$. Multiplying the two equations together, we have $N^2—C^2 = 9800$. Add C^2 to both menbers o the equation, and we have $N^2 = 9801$, the square of 99.

$(98)^2 = 9604$. Now 2, the complement of 98 from $98 = 96$; call it hundreds, and add the square of 2, and we have 9604, the square of 98.

$(97)^2 = 9409$. The complement 3 from $97 = 94$; call it hundreds, and add the square of 3, and we have the square of 97.

$(96)^2 = 9216$. The complement of 96 is 4; 4 from $96 = 92$, call it hundreds, and add the square of 4, and we have the square of 96.

$(95)^2 = 9025$. The completent of 95 is 5; $95 — 5$ 90, call it hundreds, and add the square of 5, and we have the square of 95.

$(101)^2 = 10201$. The supplement of 101 is 1;

1 added to 101 is 102, call it hundreds, and add the square of 1, and we have 10201 the square of 101.

$(102)^2 = 10404$. The supplement is 2, added to 102 is 104, call it hundreds, and add the square of 2, and we have 10404 the square of 103.

RULE.—*When above the base, add the supplement, call it hundreds, and add the square of the supplemeut, call it hundreds, because the number when increased by the supplement, is multiplied by one hundred in this case, when below, substract the complement.*

$(103)^2 = 10609$. The supplement 3 added, call it hundreds, and add the square of 3.

$(104)^2 = 10816$.

$(1001)^2 = 1002001$. The supplement is 1 added to $1001 = 1002$, call it thousands, and add the square of 1, and it equals 1002001. $(1002)^2 = 1004004$. $(1003)^2 = 1006009$. $(1004)^2 = 1008016$.

$(999)^2 = 998001$. The complement is 1 from 999 equals 998, call it thousands, and add the square of 1, and we have the square of the number. $(998)^2 = 996004$. $(997)^2 = 994009$. $(996)^2 = 992016$. $(995)^2 = 990025$. $(994)^2 = 988036$, etc.

Take any number that is easy to multiply by for the base 10, 20, 30, 50, 80, 100, 1000, etc.

$9^2 = 81$. The complement of 9 is 1, 1 from

9 leaves 8, call it tens and add the square of 1, and we have the square of 9.

$8^2 = 64$. The complement of 8 is 2, 2 from 8 leaves 6, call it tens, and add the square of 2, and we have the square of 8.

$(11)^2 = 121$. The supplement of 11 is 1, 1 added to 11 is 12, call it tens and add the square of 1, and we have the square of 11.

$(12)^2 = 144$. The supplement is 2, 2 added to 12 is 14, call it tens and add the square of 2, and we have the square of the number.

$(13)^2 = 169$. The supplement of 13 is 3, 3 added is 16, call it tens and add the square of 3, and we have the square of the number.

$(14)^2 = 196$. $(15)^2 = 225$.

$(19)^2 = 361$. The complement is 1, 1 from 19 leaves 18, 18 multiplied by 20, equals 360, add the square of 1, and we have the square of the number.

$(18)^2 = 324$. $(17)^2 = 289$. $(16)^2 = 256$. $(21)^2 = 441$. $(22)^2 = 484$. $(49)^2 = 2401$. The complement is 1, 1 from 49 is 48, call it fifties, and add the square of 1, and we have 2401, Ans.

$(51)^2 = 2601$. $(52)^2 = 2704$. $(53)^2 = 2809$.

To multiply numbers.

RULE.—*The product of any two numbers is the square of their mean, diminished by the square of half their difference.*

$19 \times 21 = 399$. The mean is 20, the square of 20 is 400; $400 - 1^2$ is 399, the product of 19 ×

21, 18×22. The mean is 20, the square of 20 is 400, 2^2 is 4; 4 from 400 leaves 396, the product, $17 \times 23 = 391$. The square of 3 is 9; 9 from 400 leaves 391 the product.

$16 \times 24 = 384$. The square of 4 is 16. 16 from 400 leaves 384 the product.

$15 \times 25 = 375$. The square of 5 is 25. 25 from 400 leaves 375 the product.

$29 \times 31 = 899$. The mean is 30. The square is 900, minus the square of 1 is 899 their product.

$28 \times 32 = 896$. The square of the mean is 900, minus the square of 2 is 896 the product.

$27 \times 33 = 891$.	$26 \times 34 = 884$.	$25 \times 35 = 875$.
$39 \times 41 = 1599$.	$38 \times 42 = 1596$.	$37 \times 43 = 1591$.
$36 \times 44 = 1584$.	$35 \times 45 = 1575$.	$34 \times 46 = 1564$.
$49 \times 51 = 2499$	$48 \times 52 = 2496$.	$47 \times 53 = 2491$.

GREATEST COMMON FACTOR OR DIVISOR

What is the greatest common divisor of 21 and 77. Separating the numbers into their prime factors we have $21 = 7 \times 3$, $77 = 7 \times 11$, hence 7 is the greatest common factor or the greater common divisor of the two numbers.

Rule.—*Separate the numbers into their prime factors. The product of all the factors that are common will be the greatest common divisor.*

What is the greatest divisor of 25 and 60. 25 $=5\times5$, $60=5\times3\times2\times2$? Hence 5 is the greatest common divisor.

What is the greatest common divisor of 5, 15 and 20?

What is the greatest common divisor of 36, 18, 24 and 12. $36=6\times6$, $18=6\times3$, $24=6\times4$, 12 $=6\times2$? Hence 6 is the greatest common factor or divisor.

What is the greatest common divisor of 135 and 225?

What is the greatest common divisor of 4, 8, 12, 16?

What is the greatest common divisor of 25 and 75?

What is the greatest common divisor of 13 and 65?

What is the greatest common divisor of 14 and 42?

LEAST COMMON MULTIPLE.

A multiple of a number is any number which contains it as a factor.

A common multiple of two or more numbers is any number which contains them all as factors.

The least common multiple of two or more numbers is the least number which contains them all as factors. Hence it follows a multiple

of a number must contain all the prime factors of that number.

A common multiple of two or more numbers must contain all the prime factors of those numbers.

The least common multiple of two or more numbers must be the least number that contains all the prime factors of those numbers.

RULE.—*The product of all the prime factors of that number having the greatest number of prime factors, and those prime factors of the other numbers not found in the factors of the nnmber taken, will be the least common multiple.*

What is the least common multiple of 12 and 18? $12=2\times2\times3$, $18=2\times3\times3$. The least common multiple is $2\times2\times3\times3$ or 36.

What is the least common multiple of 4 and 6?

What is the least common multiple of 18 and 36?

What is the least common multiple of 4, 6, 8 and 10?

What is the least common multiple of 2, 4, 6, 9 and 18?

What is the least common multiple of 2, 3, 4, 5 and 6?

RULE FOR ADDING AND SUBTRACTING FRACTIONS.

First make the fractions similar by reducing them to the same denominator. Add the numer-

ators and place the sum over the common denominator. In subtraction write the difference of the numerators over the common denominator.

What is the sum of $\frac{1}{7}$ and $\frac{1}{5}$, $\frac{1}{7}=\frac{5}{35}$, $\frac{1}{5}=\frac{7}{35}$, $\frac{5}{35}+\frac{7}{35}=\frac{12}{35}$, Ans. $\frac{2}{3}+\frac{1}{3}=1$, $\frac{1}{2}+\frac{2}{3}=1\frac{1}{6}$.

What is the sum of $\frac{5}{12}$ and $\frac{1}{4}=\frac{2}{3}$.

What is the sum of $\frac{9}{10}$ and $\frac{4}{7}=1\frac{5}{7}$.

What is the sum of $\frac{2}{5}$ and $\frac{5}{8}=1\frac{1}{40}$.

What is the sum of $\frac{8}{9}$ and $\frac{1}{6}=1\frac{1}{18}$.

What is the sum of $\frac{3}{8}$ and $\frac{2}{3}=1\frac{1}{24}$.

From $\frac{3}{4}$ subtract $\frac{1}{3}=\frac{5}{12}$.

From $\frac{2}{3}$ subtract $\frac{3}{8}$. $\frac{2}{3}=\frac{16}{24}$, $\frac{3}{8}=\frac{9}{24}$, $\frac{16}{24}-\frac{9}{24}=\frac{7}{24}$.

From $\frac{6}{25}$ take $\frac{1}{5}$. $\frac{1}{5}=\frac{5}{25}$, $\frac{6}{25}-\frac{5}{25}=\frac{1}{25}$.

What is the sum of $3\frac{1}{2}$, $2\frac{1}{3}$, $4\frac{1}{2}$, $5\frac{1}{2}=15\frac{5}{6}$.

Add the fractions and whole numbers separately.

What is the sum of $9\frac{1}{3}$, $6\frac{1}{2}$, $7\frac{2}{3}=23\frac{1}{2}$.

From $8\frac{1}{2}$ take $3\frac{1}{4}$, $\frac{1}{2}=\frac{2}{4}$, $\frac{2}{4}-\frac{1}{4}=\frac{1}{4}$. $8-3=5$; $5+\frac{1}{4}=5\frac{1}{4}$.

From $23\frac{2}{3}$ take $9\frac{1}{2}$. $\frac{2}{3}=\frac{4}{6}$, $\frac{1}{2}=\frac{3}{6}$, $\frac{4}{6}-\frac{3}{6}=\frac{1}{6}$, $25-9=14+\frac{1}{6}=14\frac{1}{6}$.

GENERAL PRINCIPLES OF FRACTIONS.

Multiplying the numerator multiplies the fraction.

Dividing the numerator divides the fraction.

Multiplying the denominator divides the fraction.

Dividing the denominator multiplies the fraction.

Multiplying both terms of the fraction by the same number does not change its value.

Fractions are called similar when they have a common denominator, as $\frac{3}{8}$, $\frac{7}{8}$, $\frac{5}{8}$, $\frac{1}{8}$.

Dissimilar fractions are fractions which are not alike, as $\frac{2}{7}$, $\frac{2}{4}$, $\frac{3}{5}$, ^{5}, $\frac{4}{9}$.

The numerators of similar fractions only can be added.

The common denominator is written under the sum or difference.

Multiply $\frac{4}{11}$ by $8=\frac{32}{11}=2\frac{10}{11}$.

Multiply $\frac{5}{14}$ by $14=\frac{70}{14}=5$.

Multiply 40 by $\frac{5}{8}=5\times 5=25$.

Multiply $3\frac{1}{2}$ by 6. Multiply the whole number and fraction separately. $6\times\frac{1}{2}=3$, $6\times 3=18\times 3=21$.

Multiply $4\frac{1}{3}$ by 8. $8\times\frac{1}{3}=2\frac{2}{3}$, $8\times 4=32+2\frac{2}{3}=34\frac{2}{3}$.

Multiply $7\frac{1}{2}$ by 9. $9\times\frac{1}{2}=4\frac{1}{2}$, $9\times 7=63+4\frac{1}{2}=67\frac{1}{2}$.

Multiply $8\frac{1}{2}$ by 12. $12\times\frac{1}{2}=6$, $12\times 8=96+6=102$.

Multiply $7\frac{1}{4}$ by $7\frac{1}{4}$. $7\frac{1}{4}\times 7\frac{1}{4}=52.\frac{9}{16}$

Multiply $7\frac{1}{2}$ by $7\frac{1}{2}=56\frac{1}{4}$.

Multiply $8\frac{2}{3}$ by $8\frac{1}{3}=72\frac{2}{9}$.

Multiply $9\frac{2}{7}$ by $9\frac{5}{7}=90\frac{10}{49}$.

DIVISION OF FRACTIONS.

RULE.—*Reduce mixed numbers to improper fractions, and whole numbers to the form of fractions; multiply the dividend by the divisor inverted, or multiply both numerator and denominator by the least common multiple of the denominators of the fractional parts.*

$\frac{6}{2\frac{1}{2}}=\frac{12}{5}=2\frac{2}{5}$. Simply multiplying numerator and denominator by 2.

Divide $5\frac{1}{2}$ by $2\frac{1}{3}$. Multiply both numerator and denominator by 6, the least common multiple of 2 and 3.

Divide 25 by $\frac{1}{2}=50$.

Divide 21 by $3\frac{1}{3}=\frac{63}{10}=6\frac{3}{10}$.

To divide any number by $3\frac{1}{3}$, remove the point one place to the left and multiply by 3.

Divide 20 by $3\frac{1}{3}$. Remove the point one place we have 2, $2\times3=6$ Ans.

Divide 27 by $3\frac{1}{3}=8\frac{1}{10}$.

To divide any number by $2\frac{1}{2}$, remove the point one place to the left and multiply by 4.

Divide $20\frac{5}{10}$ by $2\frac{1}{2}$. Remove the point one place to the left and multiply by 4.

Removing the point one place to the left makes $2\frac{5}{100}$, $2\frac{5}{100}\times4=8\frac{1}{5}$ Ans.

To divide any number by $1\frac{1}{9}$, remove the point one place to the left and multiply by 9. Divide 11 by $1\frac{1}{9}=9\frac{9}{10}$.

Divide any number by 5. Remove the point

one place and multiply by 2. Removing the point one place to the left divides the number by 10. In dividing by 10 we divide by a number twice too large; therefore we multiply by 2 for the correct result.

To divide any number by $12\frac{1}{2}$, remove the point two places to the left and multiply by 8.

Divide 125 by $12\frac{1}{2}$.

Divide 47 5 by $12\frac{1}{2}$.

Divide 96 by $12\frac{1}{2}$.

Divide 99 by $12\frac{1}{2}$.

To divide any number by 25, remove the point two places to the left and multiply by 4.

To divide any number by $33\frac{1}{3}$, remove the point two places to the left aud multiply by 3.

To divide any number by 50, remove the point two places to the left and multiply by 2.

To divide by $66\frac{2}{3}$, remove the point two places to the left, divide by 2 end multiply by 3.

TO FIND THE VALUE OF CURRENCY WHEN GOLD IS AT A STATED PRICE.

When gold is $111\frac{1}{9}$, what is the value of \$1.00 currency? We take the 100, thenumber of cents in a dollar, as the numerator, and the value of the gold as the denominator. Simplify the fraction by multiplying the numerator and de-

nominator by 9 and we have $\frac{9}{10}$ of a dollar or 90 cents; the value of the currency.

When gold is $109\frac{1}{9}$, what is the value of $1.00 currency?

$$\frac{100}{109} = \frac{900}{982} = \frac{450}{491} = \$.91\frac{319}{491}$$

When currency is worth 75 cents, what is the value of gold?

$$\frac{100}{75} = \frac{4}{3}, \ \frac{4}{3} \text{ of 100 cents equals } \$1.33\tfrac{1}{3}.$$

When gold is worth $105\frac{1}{2}$, what is the value of $1.00 currency?

$$\frac{100}{105\frac{1}{2}} = \frac{200}{211} = \$.94\frac{166}{211}$$

Rule.—*We take* 100, *the number of cents in a dollar, for the nuuerator, and the value of gold or currency, as the case may be, for the denominator. Simplify the fraction by annexing ciphers to the numerator and dividing by the denominator.*

Interest Table and Form for Making Tables.

Rhe following Table gives the Interest on any amount at 7 per cent., by simply removing the point to right or left, as the case may require:

Number of Days.	$100	$90	$80	$70
1	.0192	.01726	.01534	.01342
2	.0384	.03452	.03058	.02685
3	.0575	.05178	.04603	.04027
4	.0767	.06904	.06137	.05370
5	.0959	.08630	.07671	.06712
6	.1151	.10356	.09205	.08055
7	.1342	.12082	.10740	.09897
8	.1532	.13808	.12274	.10740
9	.1726	.15534	.13808	.12089
90	1.7260	1.5342	1.38082	1.20822
93	1.7836	1.60521	1.42685	1.24849
100	1.9178	1.82603	1.53425	1.24247

$60	$50	$40	$30	$20
.01151	.00950	.00767	.00575	.00384
.02301	.01918	.01534	.01151	.00767
.03452	.02877	.02301	.01726	.01151
.04603	.02836	.03068	.02301	.01536
.05753	.04795	.03836	.02877	.01918
.06904	.05753	.04603	.03452	.02313
.08055	.06712	.05370	.04027	.02685
.09205	.07671	.06137	.04603	.03068
1.0356	.08630	.06904	.05178	.03452
1.03562	.86301	.69041	.51781	.34521
1.07014	.89178	.71342	.53508	.35671
1.15065	.95890	.76712	.57534	.48356

To Find the Difference of Time between Two Dates by the following Table:

Rule.—*Opposite the day of the month is written the number of days of the year which have expired. Subtract this number from the whole number of days that have expired at the last date.*

Thus: What is the time from the first day of March to the 27th day of September? The 1st day of March we find by the table that 60 days of the year are gone. The 27th day of September we find that 270 days are gone. Hence 270 days minus 60 days equals 210 days, the time between the two dates.

To Find the Day of the Week from the Day of the Month by the same Table:

Cast the sevens out of the day of the month, the ratio of the month, the ratio of the year which is 3, and the year. One of a remainder will be the first day of the week, two, second, etc. 0 the last day of the week. The ratio of the month is found above its name. The ratio of every month except January and February is one more in Leap Years.

3		6		6		2		4		0	
January		February		March		April		May		June	
1	1	1	32	1	60	1	91	1	121	1	152
2	2	2	33	2	61	2	92	2	122	2	153
3	3	3	34	3	62	3	93	3	123	3	154
4	4	4	35	4	63	4	94	4	124	4	155
5	5	5	36	5	64	5	95	5	125	5	156
6	6	6	37	6	65	6	96	6	126	6	157
7	7	7	38	7	66	7	97	7	127	7	158
8	8	8	39	8	67	8	98	8	128	8	159
9	9	9	40	9	68	9	09	9	129	9	160
10	10	10	41	10	69	10	100	10	130	10	161
11	11	11	42	11	70	11	101	11	131	11	162
12	12	12	43	12	71	12	102	12	132	12	163
13	13	13	44	13	72	13	103	13	132	13	164
14	14	14	45	14	73	14	104	14	134	14	165
15	15	15	46	15	74	15	105	15	135	15	166
16	16	16	47	16	75	16	106	16	136	16	167
17	17	17	48	17	76	17	107	17	137	17	168
18	18	18	49	18	77	18	108	18	138	18	169
19	19	19	50	19	78	19	109	19	139	19	170
20	20	20	51	20	79	20	110	20	140	20	171
21	21	21	52	21	80	21	111	21	141	21	172
22	22	22	53	22	81	22	112	22	142	22	173
23	23	23	54	23	82	23	113	22	143	23	174
24	24	24	55	24	83	24	114	24	144	24	175
25	25	25	56	25	84	25	115	25	145	25	176
26	26	26	57	26	85	26	116	26	146	26	177
27	27	27	58	27	86	27	117	27	147	27	178
28	28	28	59	28	87	28	118	28	148	28	179
29	29			29	88	29	119	29	149	29	180
30	30			30	89	30	120	30	150	30	181
31	31			31	90			31	151		

2 July		5 August		1 September		3 October		6 November		1 December	
1	182	1	213	1	244	1	274	1	305	1	335
2	183	2	214	2	245	2	275	2	306	2	336
3	184	3	215	3	246	3	276	3	307	3	337
4	185	4	216	4	247	4	277	4	308	4	338
5	186	5	217	5	248	5	278	5	309	5	339
6	187	6	218	6	249	6	279	6	310	6	340
7	188	7	219	7	250	7	280	7	311	7	341
8	189	8	220	8	251	8	281	8	312	8	342
9	190	9	221	9	252	9	282	9	313	9	343
10	191	10	222	10	253	10	283	10	314	10	344
11	192	11	223	11	254	11	284	11	315	11	345
12	193	12	224	12	255	12	285	12	316	12	346
13	194	13	225	13	256	13	286	13	317	13	347
14	195	14	226	14	257	14	287	14	318	14	348
15	196	15	227	15	258	15	288	15	319	15	349
16	197	16	228	16	259	16	289	16	320	16	350
17	198	17	229	17	260	17	290	17	321	17	351
18	199	18	230	18	261	18	291	18	322	18	352
19	200	19	231	19	262	19	292	19	323	19	353
20	201	20	232	20	263	20	293	20	324	20	354
21	202	21	233	21	264	21	294	21	325	21	355
22	203	22	234	22	265	22	295	22	326	22	356
23	204	23	235	23	266	23	296	23	327	23	357
24	205	24	236	24	267	24	297	24	328	24	358
25	206	25	237	25	268	25	298	25	329	25	359
26	207	26	238	26	269	26	299	26	330	26	360
27	208	27	239	27	270	27	300	27	331	27	361
28	209	28	240	28	271	28	301	28	332	28	362
29	210	29	241	29	272	29	302	29	333	29	363
30	21	30	242	30	273	30	303	30	334	30	364
31	21	31	243			31	304			31	365

POWERS AND ROOTS.

The product of a number taken any number of times as a factor, is called a power of the number.

A root of a number is such a number as taken some number of times as factor will produce a given number.

If the root is taken twice as a factor to produce the number, it is the square root. If three times, the cube root. If four times, the fourth root, etc.

ILLUSTRATION.—5 is the square root of 25. The cube root of 125. The fourth root of 625, because $(5)^2=25$, $(5)^3=125$, $(5)^4=625$.

$(1)^2=1$	$(1)^3=1$
$(2)^2=4$	$(2)^3=8$
$(3)^2=9$	$(3)^3=27$
$(4)^2=16$	$(4)^3=64$
$(5)^2=25$	$(5)^3=125$
$(6)^2=36$	$(6)^3=216$
$(7)^2=49$	$(7)^3=343$
$(8)^2=64$	$(8)^3=512$
$(9)^2=81$	$(9)^3=729$
$(10)^2=100$	$(10)^3=1000$

We observe that the square of any one of the digits is less than 100. And the cube of any one of the digits is less than 1000. Hence the square root of two figures cannot give more than one figure.

Hence if we begin at the right of any number and separate it into periods of two figures each, the number of periods would be the same as the number of figures in its square root.

In order to understand the method of extracting square root, it is necessary to consider how the square of a number consisting of two parts is formed from those parts.

To do this let a represent any number whatever, b represent any other number, then will $a+b$ represent the sum and $(a+b)^2$ the square of the sum of any two numbers, but since the square of any two terms is the square of the first, plus two times the first into the second, plus the square of the second: we have $(a+b)^2 = a^2 + 2\,a\,b + b^2$.

ILLUSTRATIONS. — 23 here $a=20$ and $b=3$. Hence $(a+b)^2$ will equal $(20+3)^2$. In applying the above formally, commence at the units instead of the tens to find the square of the number. Thus 3^2 is 9, two times 3 into 2 is 12. Write down the 2 and carry the 1 to the square of the first term 2, and we have 529, the square of 23 and 23 is the square root of 529.

The square of any number of terms is the square of the first, plus two times the first into the second, plus the square of the second, plus two times the sum of the first two into the third, plus the square of the third, plus two the sum of the first three into the fourth, plus the square of

the fourth, etc. Note—In applying the above formula commence at the units to square numbers.

Method of Extracting Square Root.

$^{2}\overset{1}{6}25$. This number contains two periods; hence there are two figures in the roots. The greater square below 6, the first or left hand period is 4, the root of which is 2; and since there are two figures in the root, 2 will stand in the tens place and equal 20. Hence, we subtract the square of 20, which is 400, from 625, and we have 225 remaining. We have found a square 20 feet on a side. Now, in order to preserve the square, we make the addition on two adjacent sides. Hence, we double 20, the length of one side, and get 40, the trial divisor; dividing 225 by 40, we get the width of the addition, 5 feet; adding 5 feet to 40 feet, the width of the little square in the corner, we get 45, the true divisor. Multiplying 45 by 5, we get 225, the surface of the addition. Hence, 25 is the length of one side of a square that contains 625 square feet.

		100	15625(100+20+5
1st trial divisor		200	10000
1st true	"	220	5625
2d trial	"	240	4400
			1225
2d true	"	245	1225

We may have an infinite number of ways for finding the square root of any number.

Thus: Presume the root of the number to be divided into a certain number of equal parts. Let 5 a equal the square root of 15625. Since the square of the root is equal to the number $(5a)^2$ or, $25a^2=15625$ and $a^2=625$, and $a=25$. $5a$ is the root$=125$. Presume the root of 15625 to be $75a$, then $(25a)^2=625(a)^2=15625$, $(a)^2=25$, $a=5$, $25a=125$. In the same way, we may presume the root to be divided into 2, 3, 4, 5, or any number of equal parts. Hence the rule: Divide any number by the square of two, extract the square root of the quotient, and we have one half of the root of the number.

Divide any number by the square of three, extract the square root of the quotient, and we have one third of the root of the number.

Divide any number by the square of four, extract the square root of the quotient, and we have a fourth of the square root of the number, etc.

What is the square root of 9604?
What is the square root of 2401?
What is the square root of 225?
What is the square root of 64?

CUBE ROOT.

Relation of Cube to Root.

$1^3 = 1$
$2^3 = 8$
$3^3 = 27$
$4^3 = 64$
$5^3 = 125$
$6^3 = 216$
$7^3 = 343$
$8^3 = 512$
$9^3 = 739$
$10^3 = 1000$

By observation we see that the entire part of the cube root of any number below 1000 will be less than 10, and will, therefore, contain but one figure. The entire part of the cube root of a number containing four, five or six figures, will contain two figures, and so on with the larger numbers.

Hence: If we begin at the right of any number, and separate it into periods of three figures each, the number of periods will equal the number of figures in the entire part of the cube root. The cube of the highest denomination will be found in the left hand period. The cube of the two highest will be found in the two left hand periods, etc.

A cube of any number of terms, is the cube of the first term, plus three times the square of the first into the second, plus three times the first into the square of the second, plus the cube

of the second, plus three times the square of the sum of the first two into the third, plus three times the sum of the first two into the square of the third, plus the cube of the third, etc.

Method of Extracting Cube Root.

10000	$^{3}1\,^{2}953\,^{1}125$(100+20+5
	1 000 000
30000 Trial-divisor.	
6000	953 125
400	728 000
36400 1st true-divisor	225 125
6000	225 125
800	
43200 2d trial divisor.	
1800	
25	
45025 2d true divisor.	

Explanation.—We separate the number into periods of three figures each, by placing small digits over the periods. We find the greatest cube in the first or left hand period, which is 1, the cube root of which is 1; and since there are three periods, there will be three figures in the root, and this 1 will stand in hundreds place and equal 100. We will presume the linear edge of a cubical block to be 100 feet. The surface of one side will be 100 times 100, or

10000 square feet, and the solid contents will be 100 times 10000, or 1000000 solid feet; subtracting this number from the given number, we have 953125 feet remaining.

To increase this cube and preserve the cubical form, we must make the addition on three adjacent sides; and since 10000 is the surface of one side, three times 10000, or 30000 will be the surface of three sides, which forms the trial divisor; dividing the dividend by this number, we find 20, the thickness of the addition; but besides these three large square pieces, there are three parallelopipedons, the length of each 100 feet, the width 20 feet. Hence, these surfaces would be 20 times 300, or 6000. The little cube is 20 feet each way, the surface of one side of it would be 20 times 20, or 400, adding 30000, 6000 and 400, we have 36400, the sum of the surfaces of one side of each of the pieces making the addition. Multiply 36400 by 20, the thickness of the addition, we have 728000 the solid content of the addition. Subtractiug from the last dividend, we have 225125 feet to be still added. The next trial divisor is three sides of the complete cube; by observation we see that 36400 lacks of being three sides of the complete cube. One side of each of the parallelopipedons and two sides of the little cube. Hence, by bringing down 6000 and doubling 400, adding the 36400, we obtain three sides of the com-

plete cube, or the trial divisor; dividing, we find the thickness to be 5 feet. The three deficiencies, the length of one is 120 feet, the length of three would be 360 feet, the width 5 feet, the sum of the surfaces of one side of each would be five times 360 feet, which is 1800; the surface of one side of the small cube would be 5 times 5, or 25, adding to the 43200, we have 45025 feet; multiply by 5 to get the solid contents of the last addition; if there were another figure in the root, we would simply bring down the 1800, double 25, and add to the last true divisor for the next trial divisor. This method of finding trial divisors is of universal application, and the rule may be stated thus:

Add to each true divisor, as they occur, twice the surface of one side of the small tube, and one each of the three parallelopipedons for the trial divisor, for that will make three sides of the complete cube.

We may have an infinite number of ways of finding the cube root of any number.

Since the cube root of a number raised to the third power is always equal to the number, we may presume the cube root of 1953125 to be divided into five equal parts represented by $5a$. The cube of $(5a)^3$ or $125a^3 = 1953125$, and a^3 will equal $1953125 \div 125 = 15625$. The cube root of 15625 is 25, $a=25$; $5a=125$ the cube root of the number.

In the same way we might presume the root to be divided into 25 equal parts represented by $25a$. $25a^3$ or $15625a^3=1953125$, and $a^3=125$ and $a=5$ and $25a$ the root of the number equals 5 times 25 or 125.

RULE.—*Divide any number by the cube of* 2, *extract the cube root of the quotient and we have half thecube root of the number. Divide any number by the cube of* 3 *or* 27, *extract the cube root of the quotient and we have one third of the root of the number. Divide any number by the cube of* 4 *or* 64, *extract the cube root of the quotient and we have one fourth of the root of the number. Divide any number by the cube of* 5 *or* 125, *extract the cube root of the quotient and we have one fifth of the root of the number, etc.*

EXAMPLES IN CUBE ROOT.

$$
\begin{array}{r}
1728)110592(64 \\
10368 \\
\hline
6912 \\
6912
\end{array}
$$

Presume the root to be divided into twelve equal parts. Hence the cube root of the quotient of the number divided by the cube of twelve, is $\frac{1}{12}$ of the root of the number.

The cube of 12 is 1728, $110592 \div 1728 = 64$, and the cube root of 64 is 4, 4 is $\frac{1}{12}$ of the cube root, the cube root would be 12 times 4 or 48.

What is the cube root of 59319?

Presume the root to be divided into 13 equal parts.

What is the cube root of 117649?

Presume the root to be divided in 7 equal parts.

What is the cube root of 97336?

Presume the root to be divided in 23 equal parts.

What is the cube root of 95112?

Let the root be divided into 29 equal parts.

The number divided by the cube of 29 equals 8, and the cube root of 8 is 2. Hence 29 times 2 is the cube root of the number or 58.

What is the cube root of 91125?

Let the root be divided into 9 equal parts, the number divided by the cube of 9 equals 125, the cube root of 125 is 5. Hence 9 times 5 or 45 is the cube root of the number.

What is the cube root of 216×343?

The cube root of 216 is 6. The root of 343 is 7.

The cube root of the product is 6 times 7 or 42.

What is the cube root of 64×125?

The cube root of 64 is 4. The cube root of 125 is 5, $5\times4=20$. The cube root of the product.

What is the cube root of $125\times125=5\times5$?

What is the cube root of $125\times15625=5\times25$

What is the cube root of 512×729 ?

The cube root of 512 is 8. The cube root of 729 is 9.

The cube root of the product is 8×9 or 72.

What is the cube root of 216×729 ?

The cube root of 216 is 6. The cube root of 729 is 9.

The cube root of the product is 6×9 or 54.

The methods which we have presented are of universal application, and are fully and clearly illustrated by Henderson's book of blocks illustrating roots, copyrighted the 11th day of May, A. D. 1872.

SQUARE AND CUBE ROOT OF FRACTIONS.

To square a fraction, we square its numerator for the numerator, and its denominator for the denominator. Hence, to find the square root of a fraction, we must extract the square root of its numerator, for the numerator of the answer, and the square root of its denominator for the denominator of the answer.

ILLUSTRATIONS.—Find the square root of $\frac{4}{9}$. The square root of 4, the numerator is 2. The square root of 9, the denominator, is 3. Hence the answer, $\frac{2}{3}$.

What is the square root of $\frac{25}{100}=\frac{5}{10}$.

What is the square root of .0081 = .09.

When both terms of the fraction are not perfect squares, only an approximate value of the root can be obtained.

In order that the denominator of a decimal fraction may be a perfect square, its numerator must contain an even number of decimal places. Hence, to extract the square root of a decimal fraction, make its number of decimal places even, by annexing a zero, if necessary; extract the root, as in whole numbers, observing that there will be one decimal place in the root for every two in the given fraction, the root may be found to any number of decimal places by annexing two zeros for every additional figure.

To extract the cube root of a fraction, we extract the cube root of the numerator for the numerator of the answer, and the cube root of the denominator for the denominator of the answer. If its numerator and denominator are not perfect cubes, the approximate value of the cube root can only be obtained. If the denominator is not a perfect cube, both terms should be multiplied by the square of the denominator. Hence, to extract the square root of a decimal fraction, annex zeros, if necessary, to make its number of decimal places some multiple of three; extract its root, as in whole numbers, observing that there will be one decimal place for every three in the given fraction.

TO FIND THE SURFACE OF PLANE FIGURES.

A triangle is a figure having three sides and three angles.

The altitude of a triangle is the perpendicular distance from the side assumed as its base to to the vertex of the opposite angle. B C is the perpendicular, and the A D the base.

RULE.—*To find the surface of any triangle, multiply the base by half the altitude.*

A right-angle triangle is a triangle having a right angle.

Lines are parallel when they lie in the same direction. A parallelogram is a four-sided figure having its opposite sides parallel.

A trepizoid is a four-sided figure, having two of its sides parallel.

A polygon is a figure bounded on all sides by straight lines.

Similar figures are those which have the same shape.

The corresponding sides are proportional.

The base of a figure is the side on which it is supposed to stand.

The altitude of a rectangle, a parallelogram or a trepizoid, is the perpendicular distance between its parallel basis.

The area of a rectangle is the length multiplied by the width.

METHOD OF MEASURING LAND.

Find the number of rods by multiplying the length by the width. Remove the point two places to the left, divide by eight and multiply the quotient by five; or remove the point two places, take $\frac{5}{8}$ of the result, and we have the number of acres. Thus: 3280 rods, the point removed two places leaves $32.80 \div 8 = 4.1$. $4.1 \times 5 = 20.5$ acres.

What is the number of acres in 2440 rods? Remove the point two places we have 24.40; $\frac{5}{8} \times 24.40$ is $15\frac{1}{4}$, the number of acres. This method is of universal application, and may be stated in the following words: *Remove the decimal point two places to the left, and $\frac{5}{8}$ of the quotient are the number of acres.*

We remove the point two places to reduce the number to units of a hundred, and since there are $\frac{8}{5}$ of a hundred rods in one acre, five times $\frac{1}{8}$ of the number of hundred rods must equal the number of acres; or simply the point removed two places and the quotient divided by $\frac{8}{5}$ equals the number of acres.

What are the number of acres in a field 160 rods wide and 480 rods long? Remove the point two places on 160, and take $\frac{5}{8}$ of the quotient, we find one acre multiplied by 480, the length, we get 480 acres, Ans.

What is the number of acres in a field 2200 rods long and 640 wide?

What is the number of acres in a field of triangular shape? The base of the triangle is 800 rods and the altitude 300; since the area is the base multiplied by half the altitude. Half the altitude is 150; remove the point two places on 800, and we have 8, and $\frac{5}{8}\times8=5$, and $5\times150=750$, the number of acres in the field.

The area of a circle also equals the square of its radius multiplied by 3.1416, the ratio of the circumference to the diameter. If the radius is two feet the area of the circle is $3.1416\times2^2=12.5664$.

Find the area of a circle 12 feet in diameter.

Find the area of a circle of 8 feet radius; of a circle of 100 feet radius.

The suface of a sphere equals the square of its diameter multiplied by 3.1416.

ILLUSTRATION.—The surface of a sphere 5 feet in diameter$=3.1416\times25$.

The surfaces of spheres are to each other as the squares of their diameters.

The solidity of a sphere equals the product of the surface multiplied by $\frac{1}{6}$ of the diameter, or it equals $\frac{1}{6}$ of the cube of the diameter multiplied by 3.1416. The solidities of spheres are to each other as the cubes of their diameters.

The solidities of similar solids are to each other as the cubes of their like dimensions.

The solidity of a cylinder equals the product of the area of its base by its altitude.

The convex surface of a cylinder equals the product of the circumference of its base by its altitude.

What is the solidity of a cylinder 8 feet high with a base 4 feet in diameter? A cylinder 12 feet high, with a base 1 foot diameter?

What is the diameter of a sphere containing 100 cubic feet?

One bushel is about $\frac{5}{4}$ of a cubic foot. Hence $\frac{4}{5}$ of the number of cubic feet equals the number of bushels nearly. The dimensions of a box are 12 feet long, 6 feet in width, and 5 feet high. How many bushels does it contain? The product of 12, 6 and 5 is 360; Number of cubic feet=288 bushels. Remove the point one place to the left and multiply by 8.

Hence the rule to find the number of bushels from the number of cubic feet.

Remove the decimal point one place to the left, and multiply the quotient by 8.

ILLUSTRATION.—In a bin of 800.9 cubic feet, remove the point one place to the left, we have 80.09; multiply by 8 and we have 640.72; the number of bushels.

To find the number of cubic feet from the bushels, simply increase the number by one quarter of itself.

What is the number of bushels that a bin will contain, 20 feet long, 8 wide, $5\frac{1}{2}$ deep?

What is the number of cubic feet in 2150 bushels?

Some of the Miscellaneous Weights to the Bushel.

60 lbs	make	1	bushel of	Wheat.
56	"	1	"	Corn.
33	"	1	"	Oats.
48	"	1	"	Barley.
56	"	1	"	Rye.
60	"	1	"	Beans.
52	"	1	"	Buckwheat.
70	"	1	"	Corn in ear.
50	"	1	"	Corn meal.
60	"	1	"	Potatoes.
50	"	1	"	Salt.
33	"	1	"	Peaches, dried.
25	"	1	"	Apples, dried.
62	"	1	"	Clover seed.
45	"	1	"	Timothy.
56	"	1	"	Flax.

SHORT METHODS IN DIVISION AND MULTIPLICATION.

Remove the point one place to the right to multiply by 10; two places to multiply by 100; three places 1000, etc.

To divide, remove it to the left.

To multiply by 25, divide by 4 and call the quotient hundreds.

Thus: $25\times480=12000$. $480\div4=120$ call it hundreds, makes 12000. Divide by 4, because 25 is one quarter of a hundred.

To multiply by $2\frac{1}{2}$ divide by 4 and call it tens; call it tens, because $2\frac{1}{2}$ is the quarter of ten.

To multiply by 125, divide by 8 and call it thousands. Call it thousands, because 125 is $\frac{1}{8}$ of a thousand.

To multiply by $12\frac{1}{2}$ divide by 8; call it hundreds.

To multiply by $1\frac{1}{4}$ divide by 8; call it tens.

To multiply by $62\frac{1}{2}$ divide by 16 and call it thousands.

To multiply by $6\frac{1}{4}$ divide by 16 and call it hundreds.

To multiply by $31\frac{1}{4}$ divide by 32 and call it thousands.

To multiply by $333\frac{1}{3}$, divide by 3 and call it thousands.

To multiply by $33\frac{1}{3}$, divide by 3 and call it hundreds.

To multiply by $3\frac{1}{3}$, divide by 3 and call it tens.

To multiply by 50, divide by 2 and call it hundreds.

To multiply by $66\frac{2}{3}$, divide by 15 and call it thousands.

To multiply by $6\frac{2}{3}$, divide by 15 and call it hundreds.

To multiply by $833\frac{1}{3}$, divide by 12 and call it ten thousands, by annexing four ciphers.

To multiply by $83\frac{1}{3}$, divide by 12 and call it thousands.

To multiply by $8\frac{1}{3}$, divide by 12 and call it hundreds. Divide by 12 and call it hundreds.

because $8\frac{1}{3}$ is $\frac{1}{12}$ of a hundred. The reason is similar in each case.

The primitive meaning of reason is hook something to hold on by. Please get the reason in each case.

To multiply by $166\frac{2}{3}$, divide by 6 and call it thousands; because $166\frac{2}{3}$ is $\frac{1}{6}$ of 1000.

To multiply by $16\frac{2}{3}$, divide by 6 and call it hundreds.

To multiply by $1\frac{2}{3}$, divide by 6 and call it tens.

To multiply by $37\frac{1}{2}$, take $\frac{3}{8}$ of the number and call it hundreds; $87\frac{1}{2}$, $\frac{7}{8}$ of the number, and call it hundreds, etc.

We simply reverse these methods to divide.

To divide by 10, 100, 1000, etc., we remove the point one, two, and three places to the left.

To divide by 25, remove the decimal point two places to the left and multiply by 4.

Removing the point two places divides by one hundred; hence the quotient is 4 times to small; hence we remove the point two places and multiply by 4.

To divide by $2\frac{1}{2}$, remove the point one place to the left and multiply by 4.

To divide by 125, remove the point three places to the left and multiply by 8.

To divide by $12\frac{1}{2}$, remove the point two places to the left and multiply by 8.

To divide by $1\frac{1}{4}$, remove the point one place to the left and multiply by 8. There are about

$1\frac{1}{4}$ cubic feet in one bushel. Hence divide the number of cubic feet by $1\frac{1}{4}$ gives the number of bushels nearly.

To divide by 625, remove the point four places to the left and multiply by 16.

To divide by $62\frac{1}{2}$, remove the point three places to the left and multiply by 16.

To divide by $6\frac{1}{4}$, remove the point two places to the left and multiply by 16.

To divide by 3125, remove the point five places to the left and multiply by 32.

To divide by $3\frac{1}{8}$, remove the point two places to the left and multiply by 32.

To divide $333\frac{1}{3}$, remove the point three places to the left and multiply by three.

To divide by $666\frac{2}{3}$, remove the point four places to the left and multiply by 15.

To divide by $66\frac{2}{3}$, remove the point three places to the left and multiply by 15.

To divide by $833\frac{1}{3}$, remove the point four places to the left and multiply by 12.

To divide by $83\frac{1}{3}$, remove the point three places to the left and multiply by 12.

To divide by $8\frac{1}{3}$, remove the point two places to the left and multiply by 12.

To divide by $166\frac{2}{3}$, remove the point three places to the left and multiply by 6. Removing the point three places divides by 1000; hence the quotient is 6 times too small. $166\frac{2}{3}$ is $\frac{1}{6}$ of 1000.

MENTAL EXERCISE.

PROBLEM 1.—Take 1, multiply by 49, extract the square root, multiply by 4, subtract 1, and extract the cube root; what is the result?

PROBLEM 2.—Take 9, divide by 2, multiply by 6, extract the cube root, multiply by 27, and extract the fourth root; what is the result?

PROBLEM 3.—Take 48, divide by 2, multiply by 4, add 4, extract the square root, multiply by 5, subtract 1, divide by seven, and what is the result?

PROBLEM 4.—Take $8\frac{2}{3}$, multiply by $8\frac{1}{3}$, subtract $\frac{2}{9}$, divide by 8, extract the square root, multiply by 40 and divide by 10; what is the result?

PROBLEM 5.—Take $1\frac{1}{2}$, multiply by $1\frac{1}{2}$, $2\frac{1}{2}$ by $2\frac{1}{2}$, $3\frac{1}{2}$ by $3\frac{1}{2}$, run it up to $12\frac{1}{2}$, in concert.

PROBLEM 6.—Take $1\frac{1}{3}$, multiply by $1\frac{2}{3}$, $2\frac{1}{3}$ by $2\frac{2}{3}$, etc., up to 12.

PROBLEM 7.—Take $1\frac{2}{5}$, multiply by $1\frac{3}{5}$, $2\frac{2}{5}$ by $2\frac{3}{5}$, etc., up to 15.

PROBLEM 8.—Take $1\frac{3}{7}$, multiply by $1\frac{4}{7}$, $2\frac{3}{7}$ by $2\frac{4}{7}$, etc., up to 20.

PROBLEM 9.—Take $1\frac{3}{8}$, multiply by $1\frac{5}{8}$, $2\frac{3}{8}$ by $2\frac{5}{8}$, etc., up to 17.

PROBLEM 10.—Take $1\frac{4}{9}$, multiply by $1\frac{5}{9}$, $2\frac{4}{9}$ by $2\frac{5}{9}$, etc.

PROBLEM 11.—Take $1\frac{5}{2}$, multiply by $1\frac{7}{12}$, $2\frac{5}{12}$ by $2\frac{7}{12}$, etc.

PROBLEM 12.—Take $1\frac{7}{11}$, multiply by $1\frac{4}{11}$, $2\frac{7}{11}$ by $2\frac{4}{11}$, etc.

PROBLEM 13.—Take $12\frac{1}{2}$, multiply by $12\frac{1}{2}$, $11\frac{1}{2}$ by $11\frac{1}{2}$, etc., down to 1.

PROBLEM 14.—Take $11\frac{1}{4}$, multiply by $11\frac{3}{4}$, $10\frac{1}{4}$ by $10\frac{3}{4}$, etc., down to 1.

PROBLEM 15.—Take $12\frac{7}{8}$, multiply by $12\frac{1}{8}$, $11\frac{7}{8}$ by $11\frac{1}{8}$, etc., down to 1.

PROBLEM 16.—Take $13\frac{3}{5}$, multiply by $13\frac{2}{5}$, $12\frac{3}{5}$ by $12\frac{2}{5}$, etc., down to 1.

PROBLEM 17.—Take $12\frac{9}{10}$, multiply by $12\frac{1}{10}$, $11\frac{9}{10}$ by $11\frac{1}{10}$, etc., down to 1.

PROBLEM 18.—Take $10\frac{7}{13}$, multiply by $10\frac{6}{13}$, etc., down to 1.

PROBLEM 19.—Take $12\frac{7}{12}$, multiply by $12\frac{5}{12}$, etc., down to 1.

PROBLEM 20.—Take $8\frac{7}{15}$, multiply by $8\frac{8}{15}$, $7\frac{7}{15}$ by $7\frac{8}{15}$, etc., down to 1.

PROBLEM 21.—Take $10\frac{9}{16}$, multiply by $10\frac{7}{16}$, $9\frac{9}{16}$ by $9\frac{7}{16}$, etc., down to 1.

PROBLEM 22.—Take $12\frac{9}{14}$, multiply by $12\frac{5}{14}$, etc., down to 1.

PROBLEM 23.—Take $11\frac{9}{20}$, multiply by $11\frac{11}{20}$, etc., down to 1.

PROBLEM 24.—Take $12\frac{1}{9}$, multiply by $12\frac{8}{9}$, etc., down to 1.

PROBLEM 25.—Take $8\frac{7}{19}$, multiply by $8\frac{12}{19}$, etc., down to 1.

PROBLEM 26.—Take $13\frac{3}{7}$, multiply by $13\frac{4}{7}$; etc., down to 1.

The mean of two numbers is half their sum, or the number equally distant from the two numbers.

The product of two numbers is the square of their mean diminished by the square of half of their difference.

PROBLEM 27.—19 times 21, 18 times 22, etc., down to 15. Thus: The mean is 20, the square of 20 is 400, 400—the square of 1 is 399; the product, 18 times 22 is the square of 20, 400—the square of 2, 4, 396. 17 times 23 is 391, 16 times 24, 384; 15 times 25, 375.

PROBLEM 28.—Take 29 by 31, 28 by 32, etc., down to 20 and up to 40.

PROBLEM 29.—Take 39 by 41, 38 by 42, etc., down to 30 and up to 50.

PROBLEM 30.—Take 49 by 51, 48 by 52, etc., down to 40 and up to 60.

PROBLEM 31.—Take 59 by 61, 58 by 62, etc., down to 50 and up to 70.

PROBLEM 32.—Take 69 by 71, 68 by 72, etc., down to 60 and up to 80.

PROBLEM 33.—Take 79 by 81, 78 by 82, etc., down to 70 and up to 90.

PROBLEM 34.—Take 89 by 91, 88 by 92, etc., down to 90 and up to 100.

The complement of a number is the difference of that number and some particular number above it. The supplement of a number is the difference of that number and some particular number below it.

Thus, the complement of 99 is the difference of 99 and 100, which is 1.

The supplement of 101 is the difference of 101 and 100, which is 1.

PROBLEM 35.—Commence at 99 and square numbers down to 90. Thus: 99 times 99 is 9801, 98 times 98 is 9604, 97 times 97 is 9409, 96 times 96 is 9216, etc. Simply diminish the number by its complement, call it hundreds and add the square of the complement.

When we use the supplement, we add it to the number, give it its proper name and add the square of the supplement.

Thus: 101 times 101, the supplement 1 added to 101 makes 102, call it hundreds, is 10200, plus the square of the supplement is 10201.

PROBLEM 36.—Commence at 101, square all the numbers up to 110 and down to 90.

PROBLEM 37.—Commence at 51, square all the numbers up to 60 and down to 40.

PROBLEM 38.—Commence at 21, square all the numbers up to 25 and down to 15.

PROBLEM 39.—Commence at 11, square all the numbers up to 15 and down to 5.

PROBLEM 40.—Commence at 999, square all the numbers down to 990 and up to 1010, etc.. etc., etc., etc.

MISCELLANEOUS PROBLEMS.

PROBLEM 1.—How many bushels in a bin 10 feet long, 4 feet wide and 4 feet deep?

SOLUTION.—Since there are $\frac{10}{8}$ of a cubic foot in one bushel, the bin will contain 8 times $\frac{1}{10}$ of the number of cubic feet, in bushels. $\frac{1}{10}$ of 10 is 1, 8 times 1 are 8, 4 times 8, 32, and 4 times 32, 128, Ans. Or find the number of cubic feet in the bin, remove the decimal point one place to the left, and multiply by 8 in all cases. Thus: the product of 4, 4 and 10 is 160; remove the point one place to the left and we have 16, 16 multiplied by 8 is 128, Ans.

PROBLEM 2.—How many bushels in a bin 32 feet long, 16 feet wide and $5\frac{1}{2}$ feet high?

PROBLEM 3.—How many bushels in a bin 24 feet long, 12 feet wide, $4\frac{1}{2}$ feet high?

PROBLEM 4.—A cubic foot of water weighs 62 lbs. 8 oz.—what is the pressure on 5 acres at the bottom of the sea, where the water is 1 mile deep?

PROBLEM 5.—What would be the weight of this planet if one cubic foot weighs $62\frac{1}{2}$ pounds?

PROBLEM 6.—If $21\frac{3}{4}$ bushels of oats are required to seed $9\frac{2}{3}$ acres, how many bushels will be required to seed a field of 100 acres?

PROBLEM 7.—If $33\frac{1}{3}$ pounds of tea cost $\$27\frac{1}{2}$, how much will 300 pounds cost?

PROBLEM 8.—A field $3\frac{1}{2}$ times as long as it is wide contains 30 acres—what are its dimensions?

PROBLEM 9.—If each one of 20 pupils breathe 30 cubic feet of air per hour, in how long a time will they breathe as much air as a room 20 by 30 and 8 feet high contains?

PROBLEM 10.—If gold is $1.12\frac{1}{2}$, what is currency worth?

SOLUTION.—The value of currency would be $\frac{100}{112\frac{1}{2}}$, simply multiplying the numerator and denominator by 2 and we have $\frac{200}{225}=\frac{8}{9}$; hence one dollar in currency is worth $\frac{8}{9}\times\frac{100}{1}$ cents, or $88\frac{8}{9}$ cents.

PROBLEM 11.—If currency is worth $88\frac{8}{9}$ cents on the dollar, what is gold worth? Simply invert the preceding operation.

PROBLEM 12.—If gold is $1.10\frac{1}{2}$, what is currency?

PROBLEM 13.—If currency is 95 cents on the dollar, what is gold?

PROBLEM 14.—If a wolf can eat a sheep in $\frac{7}{8}$ of an hour, and a bear in $\frac{3}{4}$ of an hour, how long will it take them together to eat what remains of a sheep after the wolf has been eating half an hour?

SOLUTION.—In one hour the wolf eats $\frac{8}{7}$ of a sheep, after eating half an hour $\frac{3}{7}$ of the sheep would remain, since in one hour they eat $\frac{8}{7}+\frac{4}{3}$ or $\frac{52}{21}$; to eat $\frac{3}{7}$ or $\frac{9}{21}$ of a sheep it would take them as long as $\frac{52}{21}$ is contained in $\frac{9}{21}$, which is $\frac{9}{52}$ of an hour, Ans.

PROBLEM 15.—John cuts a cord of wood in $\frac{3}{4}$ of a day, James in $\frac{2}{5}$ of a day, how long will it take them to cut a cord when they work together?

PROBLEM 16.—A can do a piece of work in 8 days and A and B can do the same in 5 days; after A did $\frac{1}{3}$ of the work, B did the remainder —how long did it take him?

PROBLEM 17.—Divide the number 108 into two such parts, that $\frac{3}{7}$ of the first $+8$ shall equal the second.

PROBLEM 18.—A ship mast 63 feet in length, in a storm, was broken off; $\frac{2}{3}$ of what was broken off equaled $\frac{3}{4}$ of what remained; how much was broken off, and how much remained?

PROBLEM 19.—A farmer has 2290 sheep in two fields, $\frac{3}{4}$ of the number in the first field equals $\frac{2}{7}$ of the number in the second; how many are there in each field?

PROBLEM 20.—A market woman was requested to buy 99 fowls, consisting of two different kinds; $\frac{1}{4}$ of the number of the first kind was to equal $\frac{2}{3}$ of the second kind; how many of each kind must she buy?

PROBLEM 21.—A farmer, after selling $\frac{2}{3}$ of $1\frac{1}{5}$ times as much grain as he had, had 100 bushels remaining; how much had he at first?

PROBLEM 22.—Divide the number 170 into two parts, that shall be to each other as $\frac{2}{3}$ to $\frac{3}{4}$.

PROBLEM 23.—$\frac{2}{3}$ of A's number of sheep plus

$\frac{3}{4}$ of B's number equals 900; how many sheep has each, providing $\frac{3}{4}$ of B's number is $\frac{4}{5}$ of A's number?

PROBLEM 24.—A gold and silver watch were bought for $320; the silver watch cost $\frac{\;}{7}$ as much as the gold one; what was the cost of each?

PROBLEM 25—$\frac{1}{2}$ of A's money + $\frac{2}{3}$ of B's; equals 6600; and $\frac{2}{3}$ of B's is 4 times $\frac{1}{2}$ of A's; how much money has each?

PROBLEM 26.—Divide the number 60 into two parts, that shall be to each other as $\frac{1}{2}$ to $\frac{3}{4}$

PROBLEM 27.—The sum of two numbers is 140, and the larger is to the smaller as 1 to $\frac{5}{9}$; what are the numbers?

PROBLEM 28.—A and B together owe $207; B owes $\frac{11}{12}$ as much as A; how much does each owe?

PROBLEM 29.—I sold a horse for $\frac{1}{8}$ more than he cost me, receiving $270 for him; how much did he cost me?

PROBLEM 30.—What will $\frac{3}{4}$ of a barrel of flour cost at $11.28 per barrel?

PROBLEM 31.—What will $\frac{5}{6}$ of a bag of coffee weigh if a bag weighs 147 lbs?

PROBLEM 32.—What will $\frac{7}{8}$ of a pound of tea cost at $1.25 per pound?

PROBLEM 33.—What will $\frac{9}{10}$ of a cord of wood cost at $6.25 per cord?

PROBLEM 34.—What will $\frac{7}{10}$ of a hogshead of wine cost at $138.75 per hogshead?

PROBLEM 35.—How much is $\frac{1}{3}$ and $\frac{1}{2}$ of $\frac{1}{3}$ of 15?

PROBLEM 36.—A and B traded in company; A put in $\frac{2}{3}$ as much as B; they gained $750; what was each man's share?

PROBLEM 37.—James says to John, give me $7.00 and I will have as much money as you. John says to James, give me $7.00 and I will have twice as much as you, Ans. 35 and 49.

Simply multiply the $7.00 by the numbers 5 and 7; and for all similar problems simply multiply the sum of money given, by the numbers 5 and 7.

PROBLEM 38.—A says to B, give me 3\frac{1}{3}$ and I will have as much money as you. B says to A, give me 3\frac{1}{3}$ and 1 will have twice as much as you. How much money has each?

PROBLEM 39.—Haight says to Booth, give me 1000 sheep and I will have as many as you. Booth says to Haight, give me 1000 and I will have twice as many as you. How much has each?

PROBLEM 40.—Friedlander says to Reese, give me $500,000 and I will have as much as you. Reese says to Friedlander, give me $500,000 and I will have twice as much as you. How much has each?

PROBLEM 41.—C says to D, give me 13.33\frac{1}{3}$ and I will have as much money as you. D says to C, give me 13.33$\frac{1}{3}$ and I will have twice as much money as you. How much has each?

PROBLEM 42.—Greeley says to Grant, give me

50,000 votes and I will have as many as you. Grant says to Greeley, give me 50,000 votes and I will have twice as many as you; how many has each?

PROBLEM 43.—Two Hoodlums go into a saloon; one says to the other, give me as much money as I have, and I will spend two bits with you. They go into another saloon, and he says, give me as much money as I now have, and I will spend two bits with you. They went into the third saloon, and he made the same statement, and when they came out of the third saloon he had nothing left. How much had he when he went into the first saloon? Ans., $1\frac{3}{4}$ bits. Simply $\frac{7}{8}$ of the sum borrowed in the first saloon is the answer.

PROBLEM 44.—A and B step into a hotel; A says to B, give me as much money as I have, and I will spend five dollars with you. They go into a second and third, A making the same statement; and when they came out of the third, he had nothing left. How much had he when they went into the first hotel?

PROBLEM 45.—If 3 be the third of 6, what will the fourth of 20 be? Ans. $3\frac{1}{3}$.

SOLUTION.—The third of 6 is 2, if 3 be 2, 1 is $\frac{1}{3}$ of 2 or $\frac{2}{3}$, and 20 is 20 times $\frac{2}{3}$ or $\frac{40}{3}$, the $\frac{1}{4}$ of 20 is the $\frac{1}{4}$ of $\frac{40}{3}$ or $\frac{10}{3}$, $3\frac{1}{3}$ Ans.

PROBLEM 46.—If the third of 6 be 3 what will the fourth of 20 be? Ans. $7\frac{1}{2}$.

SOLUTION.—If 2 be 3, 1 is $\frac{1}{2}$ of 3, $1\frac{1}{2}$ and 20 is 20 times $1\frac{1}{2}$ or 30, $\frac{1}{4}$ of 20 is the $\frac{1}{4}$ of 30 or $7\frac{1}{2}$ Ans.

GENERAL INFORMATION.

The circumference of a circle equals the diameter multiplied by 3.1416, the ratio of the circumference to the diameter.

The radius of a circle equals the circumference multiplied by 6.283185.

The area of a circle equals the square of the radius multiplied by 3.1416.

The area of a circle equals the square of the diameter multiplied by 7854.

The area of a circle equals one quarter of the diameter multiplied by the circumference.

The radius of a circle equals the circumference multiplied by 0.159155.

The radius of a circle equals the square root of the area multiplied by 0.56419.

The diameter of a circle equals the circumference multiplied by 0.31831.

The diameter of a circle equals the square root of the area multiplied by 1.12838.

The side of an inscribed equilateral triangle equals the diameter of the circle multiplied by 0.86.

The side of an inscribed square equals the diameter multiplied by 0.7071.

The side of an inscribed square equals the diameter of the circle multiplied by 0.225.

The circumference of a circle multiplied by 0.282 equals one side of a square of the same area.

The side of a square equals the diameter of a circle of the same area multiplied by 0.8862.

The area of a triangle equals the base multitiplied by one half of its altitude.

The area of an ellipse equals the product of both diameters and .7854.

The solidity of a sphere equals its surface multiplied by one-sixth of its diameter.

The surface equals the product of the diameter and circumference.

The surface of a sphere equals the square of the diameter multiplied by 3.1416.

The surface equals the square of the circumference multiplied by 0.3183.

The solidity of a sphere equals the cube of the diameter multiplied by 0.5236.

The diameter of a sphere equals the square root of the surface multiplied by 0.56419.

The square root of the surface of a sphere multiplied by 1.772454 equals the circumference.

The diameter of a sphere equals the cube root of its solidity multiplied by 1.2407.

The circumference of a sphere equals the cube root of its solidity multiplied by 3.8978.

The side of an inscribed cube equals the radius multiplied by 1.1547.

The solidity of a cone or pyramid equals the area of its base multiplied by one third of its altitude.

COLLEGE DE L'UNION.

DIPLOME DE BACHELIER DES ARTS.

Nous Directeurs du Collége de l'Union à Schenectady, Etat de New York, vu le Certificat d'aptitnde au grade de Bachelier ès Arts, accordé par la Faculté du Collége au Sieur Jean Alexandre Henderson, ratifiant le susdit Certificat. Donnons par ces présentes au dit Sieur, le Diplôme de Bachelier ès Arts, pour en jouir avec les droits et prérogatives qui y sont attachés. En témoignage de quoi nous avons muni ce Diplôme de notre sceau et des signatures du President et des Professeurs de ce Collège.

Fait à Schenectady le vingt huitieme Juillet 1864.

E. NOTT, *Pres.*
L. P. HICKOK, *Acting Pres.*
J. H. JACKSON, *Prof. de Math.*
JOHN FOSTER, *Prof. de Physique.*
GUILL. M. GILLESPIE,
Prof. de Ponts et Chausseés.
C. F. CHANDLER, *Chem. Prof.*
W. LAMOREUX,
Acting Prof. Lang. Mod.
N. G. CLARK,
Prof. des Belles Lettres.
JONATHAN PEARSON,
Prof. Hist. Nat.

N. B.—J. A. Henderson a reçu le A. M, dègré de Maître, 1867.

LE CALCULATEUR INSTANTANE.

PAR J. A. HENDERSON.

L'alphabet arithmétique est écrit et lu: Le second est deux fois le premier, le troisième trois fois le premier, et ainsi de suite jusqu'à la fin.

un un,	deux un,	trois un,	quatre un,	cinq un,	six un,	sept un,	huit un,	neuf un,	et zéro.
$\frac{1}{1}$,	$\frac{2}{1}$,	$\frac{3}{1}$,	$\frac{4}{1}$,	$\frac{5}{1}$,	$\frac{6}{1}$,	$\frac{7}{1}$,	$\frac{8}{1}$,	$\frac{9}{1}$ &	$\frac{0}{1}$.

INTÉRET.

Comme l'intérêt est généralement une portion du principal, la méthode de le calculer *viendra* sur la méthode de le diviser. La règle établira le temps quand la piastre fait un cent, et nous placerons le chiffre décimal deux places à la gauche, parceque un centième du principal égal l'intérêt. Dans dix fois le temps la piastre fait dix cents, et nous placerons le chiffre décimal une place à la gauche, parceque un dixième du principal en est l'intérêt;

dans un dixième du même temps une piastre fait un mille, et nous placerons le chiffre décimal trois places à la gauche, parceque un millième du principal en est l'intérêt.

Regle—Le réciproque du prix, ou le prix renversé indique le temps quand nous pourrons changer le chiffre décimal deux places à la gauche; en tout cas, dix fois le temps une placé à la gauche, et un dixième du même temps trois place à la gauche, augmente ou diminue le résultat afin de retrouver le temps.

L'alphabet numérical est $\frac{1}{1}$, $\frac{2}{1}$, $\frac{3}{1}$, $\frac{4}{1}$, $\frac{5}{1}$, $\frac{6}{1}$, $\frac{7}{1}$, $\frac{8}{1}$, $\frac{9}{1}$, et 0; $\frac{1}{1}$ renversé est 1; $\frac{2}{1}$ renversé est $\frac{1}{2}$; $\frac{3}{1}$ renversé $\frac{1}{3}$, etc. Si le prix est 1 pour cent par mois, 1 renversé indique le temps quand la piastre fait un cent, et le chiffre changé deux places à la gauche montre l'intérêt dans tout cas.

	Int. de 3 jours.	Int. de 1 mois.	Int. de 10 mois.	
Ainsi:	$ 2	5	6	7.35
		8	6	1.50
	9,	7	4	6.75
	11,	4	6	3.25
	22,	5	3	8.40
	1,	0	0	0.50

MÉTHODE D'ÉGALISER DES NOMBRES PAR LEUR COMPLÉMENT ET SUPPLÉMENT.

Le complément d'un nombre est la différence d'un nombre et d'un autre nombre particulier avant lui. Le supplément d'un nombre est la différence d'un nombre et d'un autre nombre après lui. $(99)^2=9801$. Prenons le complément de 99, nous l'appellerons centième, et nous ajouterons le complément pour le rendre égale.

EXPLICATION.—Laissons que N égale 99, et C égal 1. Alors N plus C=100. N—C=98. Multiplions les deux équivalents ensemble, nous avons N^2—C^2= 9800. Ajoutons C^2 aux uns et aux autres nombres, et nous aurons N^2=9801, le nombre égal de 99.

1RE REGLE. — Quand le nombre est plus haut que la base, nous ajoutons le supplément, nous l'appellerons centièmes, et nous ajouterons l'égal du supplément, nous l'appellerons centième, parce-que le nombre est augmenté par le supplément quand il est multiplié par 100; en ce cas-ci, quand le nombre est moindre que la base, nous soustrairons le complément.

2ME REGLE.—Le produit de l'un ou de l'autre de deux nombres est l'égal de leur valeur diminué par l'égal de la moitié de leur différence.

POUR TROUVER LA VALEUR DE LA MONNAIE COURANTE QUAND LE PRIX DE L'OR EST FAIT.

Quand l'or est à $111\frac{1}{9}$, qu' est la valeur de \$1.00 en monnaie courante? Nous prenons 100, le nombre de cent dans la piastre, comme le numérateur, et la valeur de l'or comme le dénominateur. Nous simplifions la fraction en multipliant le numérateur et dénominateur par 9, et nous aurons le $\frac{9}{10}$ d'une piastre, ou 90 cents, la valeur de la monnaie courante.

Quand la monnaie-courante vaut 75 cents, quel est la valeur de l'or? $\frac{100}{75}=\frac{4}{3}$, $\frac{4}{3} \times \frac{100}{1}$ cents égale \$1.33$\frac{1}{3}$.

Regle. — Nous prenons 100, le nombre de cent dans une piastre, pour le numérateur, et la valeur de l'or ou de l'argent courant, quelque soit la cause, pour le dénominateur. Nous simplifions la fraction en ajoutant un zéro au numérateur et en divisant par le dénominateur.

NOUVELLE MÉTHODE DÉCIMAL DE CALCULER L'INTÉRET ET DE L'EXPLIQUER.

Regle.—Reversé le prix, ajoutez un zéro, et mettez devant le point. Immédiatement au-dessus de ces caractères, placez le montant sur lequel l'intérêt est demandé, le centième étant toujours dans la colonne du prix.

Raisons.—Posez le prix pour trouver la règle.

Quand la piastre fait un cent. Ajoutez un zéro, vous trouverez la règle, quand une piastre fait dix cents. Mettez devant le point, vous trouverez la règle, Quand une piastre fait un mille. Quand une piastre fait un cent, vous rechangez le point deux places à la gauche: parceque un centième du principale égale l'intérêt. Quand une piastre fait dix cents, rechangez le point une place à la gauche, parceque le dixième du principal est l'intérêt. Le prix renversé invariablement représente le temps quand une piastre gagne un cent, ou cent piastres une piastre. Ainsi, pour trouver quel que soit le nombre donné de centièmes, placez le immédiatement dessous le prix renversé et vous aurez la réponse en piastres et décimes.

J. A. HENDERSON, A. M.,

Phrenologist and Phreno-Magnetic Healer.

CERTIFICATES OF APPROVAL.

I have examined the new methods of calculation by Prof. J. A. Henderson, they are invaluable to business men, and will prove a light in science to all coming generations.

A. J. WARNER,
Pres. Elmira Commercial College.

Henderson's methods are the finest known for lightning multiplication.

Prof. D. R. FORD,
Female College, Elmira.

I have examined Prof. J. A. Henderson's new methods of calculation; they are remarkable for originality and of great practical value. His methods of calculating interest are peculiarly clear and comprehensive in their adaptation to all possible cases.

Rev. Dr. O. P. FITZGERALD,
Ex. State Superintendent, Cal.

Mr. J. A. Henderson has taught mathematics in Delhi Academy for a year. We consider him an excellent mathematical teacher.

J. L. SAWYER,
Principal of Delhi Academy.

Delhi, Oct. 1862.

P. S. J. A. H., taught analytical Trignometry, University Algebra, Intellectual Arithmetic and English Grammar in Delhi Academy, New York.

John Alexander Henderson, A. M., attended Union College and graduated with me in class "64." He is an excellent scholar—among the first—and his character is above reproach.

ELISHA CURTIS, A. M.,
Principal of Sodus Academy.

I have known Prof. J. A. Henderson from earliest boyhood; his character has always been beyond reproach. As a mathematician he has scarcely an equal; as a teacher he has been eminently successful; as a phrenologist, he is considered by many not a whit behind Fowler & Wells. New York.

REV A. G. KING,
of U. P. Church, N. Y., 1869.

EXTRACT FROM J. A. HENDERSON'S PHRENO-MEDICAL CHART.

Diet, exercise, rest, light, good water and pure air develop the mental, motive and vital forces. Young maiden and young man, make these your physicians, for they insure health, success in business, give you the key to philosophy and are the handmaids of Christianity. Add intelligence and contentment, the two great pillars of felicity, and you do much to sustain the moral government of the domestic circle, the moral government of the human family, and the moral government of the Creator.

Strong faith makes a stout heart; active hope, a healthy liver; rounded up veneration, excellent functions of digestion; large firmness, strong vertebræ; fine conscientious gives not only a pure mind, but healthy kidneys eliminating all surplus secretion from the brain and body; large combativeness develops a fine osseous force; destructiveness an excellent muscular force. The mind is the root, the body the trunk, and the sciences the branches. The seat of the mind is the brain and nerves. The organs, forty in number, are the instruments used in framing constitutions and building up science. They are also the instruments used in

building up the constitution of the body. Therefore beware that you build in no error, for disease will surely follow, which is the result of insulted law. It is this law insulted that binds the body with disease; break the bands and your blood will flow like wine, and disease disappear like mist before the morning sun. Mind is *light*. Hail! holy light which lighteth everyone, in *thee* is the life of the blood, flesh and spirit, from thee the face gets its form and beauty, the eye its light, the tongue the word, the muscle its action, and every function its health and development. Hence keep all the organs of the mind and functions of the body well ventilated by being correct in diet, exercise, rest, light, good water and pure air, and the result is sound flesh and pure blood.

The child is the zero power of its parents, that is a unit of the parents, plus or minus the surrounding influences. A well balanced child has its eyes in the center of its head, that is the same distance from the point of the chin to the optics, as from the optics to the upper part of the organ of benevolence.

A wise man's eyes are in the center of the head. The face is an *index* of the strength of the will of the flesh; the brain an *index* of the strength of the will of the mind. Hence when Nature establishes an equilibrium between the two forces, the master and the servant, the will of the mind and the will of the flesh, we have harmony of character, prudence, wisdom and proficiency. The history of all nations illustrates the truth of the above propositions very clearly.

J. A. Henderson is preparing a lightning method of discerning character.

METODO INSTANTANEO

[illegible]

[illegible]

[illegible]

[illegible]

Metodo Instantáneo

DE CALCULAR

Intelectual y Practical

POR EL

PROFESOR J. A. HENDERSON,

GRADUADO EN EL COLEGIO UNION,

Y Autor del Calculador, Libro de Cuadro Ilostrando Raices, y Carta Prena-Medical.

Examinacions tocante al salud negocios y otras cosas, 542 Calle de Market, Cuatro N°. 16.

SAN FRANCISCO:

Imprenta Cosmopolitana, Calle de Clay, No. 505.

1872.

EL CALCULADOR INSTANTÁNEO.

El Alfabeto numérico, segun se escribe y se lee:

un uno....	dos unos....	tres unos...	cuatro unos.	sinco unos..	seis unos...	siete unos .	ocho unos..	nueve unos.	cero.......
$\frac{1}{1}$,	$\frac{2}{1}$,	$\frac{3}{1}$,	$\frac{4}{1}$,	$\frac{5}{1}$,	$\frac{6}{1}$,	$\frac{7}{1}$,	$\frac{8}{1}$,	$\frac{9}{1}$,	$\frac{0.}{1}$

El segundo es dos veces el primero, el tercero tres veces el primero, etc., hasta el último.

REGLA DE INTERES.

Regla.—El recíproco de la tasa ó la tasa invertida, indica el tiempo cuando en todos casos. Se puede mudar el tiempo decimal dos lugares hácia la izquierda; diez veces aquel tiempo un lugar hácia la izquierda y un désimo del mismo tiempo tres lugares hácia la izquierda. Aumentase ó disminuyase el resultado para que concuerde con el tiempo dado.

Tasa por año........		9	%	
" invertido........		1	0	
Con diez désimos....		9		
	$1	9	7	6,21
	4 dias.	40 dias	400 dias	
$\frac{3}{8}$ por mes............		3	%	
		8	0	
		3		
Ejemplo............	$15	4	9	6.25
	8 dias.	80 dias	800 dias	
	Decimos..	Unidades.	Diez.....	

A un centavo por mes ó 1%. Por ejemplo:

Int. de 3 dias.	Int. de 1 mes.	Int. de 10 mes.	
$2,	5	6	7.35
	8	6	1.50
9,	7	4	6.75
11,	4	6	3.35
22,	5	3	8.40
1,	0	0	0.50

Para obtener resultados por cualquier otro tiempo dado, se aumenta ó divide segun sea el caso.

N. B.—Se puede aplicar el mismo método á cualquier ejemplo ó tasa de interés.

MÉTODO DE CUADRAR NÚMEROS POR SUS SUPLIMENTO Y COMPLIMENTO.

El complimento de un número es la diferencia entre aquel número y otro número especial mayor que aquel. El suplimento de un número es la diferencia entre aquel número y otro número especial menor que aquel.

$99^2=9,801$. Restése el complimento de 99, llamase cientos y añádasele el cuadrado del complimento.

ESPLICACION.

Supongamos por ejemplo, que la n iguale á (99) y la c iguale á 1. Entouces n mas $c=100$. $n-c=98$. Multiplicando las dos equaciones, tendremos $n^2-c^2=9,800$. Añadanse c^2 á ambas cantidades de la equacion y tendremos $n^2=9,801$, el cuadrado de 99.

Regla.—Cuando mayor que la base, el cual es ciento añádase el suplimento, llámesele cientos y añádasele el cuadrado del suplemento llamesele cientos, por que el número cuando aumentado por el suplemento es en este caso multipli-

cado por ciento, cuando es menor réstese el complimento.

(19) $\stackrel{2}{=}$ 361. El complímento es uno 1, de 19 restamos 1 quedan 18, 18 multiplicado por 20 es igual á 360 añádase el cuadrado de 1 y tendremos el cuadrado de 19. (49) $\stackrel{2}{=}$ 2,401. El complimento es 1, de 49 restamos 1 quedan 48 llámesele quincuajésimo, añádasele el cuadrado de 1, y tenemos 2,401, por resultado.

Regla.—El producto de dos números cualquiera es el cuadrado de su media suma disminuido por el cuadrado de la mitad de su diferencia.

EL MAS COMUN FACTOR O DIVISOR.

Regla.—Sepárese los números en sus factores primitivos. El producto de todos los factores que son comunes será el mas comun divisor.

¿Cual es el mas comun divisor de 21 y 77? Separando los números en sus factores primitivos, tenemos 21=7x3, 77=7x11, de consiguiente, 7 es el mas comun factor, ó divisor de los dos números.

REGLA PARA AÑADIR Y RESTAR QUEBRADOS.

Redúzcanse primeramente todos los quebrados á un mismo denominador, añádanse los numeradores y póngase la suma sobre el denominador comun. Para restar escribase la difer-

encia de los numeradores sobre el comun denominador.

EJEMPLO.—¿ Cuanto es la suma de $\frac{1}{7}=\frac{5}{35}, \frac{1}{5}=\frac{7}{35}, \frac{5}{35}+\frac{7}{25}, =\frac{12}{35}$ resultado ?

EJEMPLO.—De $\frac{3}{4}$ restase $\frac{1}{3}=\frac{5}{12}$.

DIVISION DE QUEBRADOS.

REGLA—Reduzcanse los números fraccionarios á la forma de quebrados impropios; multiplíquese el dividiendo por el divisor invertido ó multiplíquese tanto el numerador y denominador por el mas comun multiplicador de los denominadores de los partes fraccionales.

Divídase $5\frac{1}{2}$ por $2\frac{1}{3}$, multiplíquese tanto el numerador y denominador por 6, el mas comun de 2 y 3.

PARA HALLAR EL VALOR DE MONEDA Ó PAPEL MONEDA CUANDO SE CONOCE EL PRECIO DEL ORO.

REGLA.—Tomamos 100, el número de centavos que contiene el peso fuerte para numerador y el valor del oro, ó papel moneda, segun sea el caso, para denominador. Simplifiquese el quebrado añadiendo ceros, al numerador y dividiendo por el denominador.

Cuando el oro está al valor de $109\frac{1}{2}$.

¿ Cuanto es el valor de \$1.00 moneda papel ?

EJEMPLO.—$\frac{100}{109\frac{1}{2}}=\frac{900}{982}=\frac{450}{491}=\$91\frac{340}{491}$.

Cuando el papel moneda está al valor de 75 centavos, ¿cuanto es el valor del oro?

EJEMPLO—$\frac{100}{75}=\frac{4}{3}$, $\frac{4}{3}$ de 100 centavos igual á $1. 33$\frac{1}{3}$.

METODO DE EXTRAER LA RAIZ CUADRADA.

REGLA.—Divídase cualquier número por el cuadrado de tres, estráigase la raíz cuadrada del cociente y tenemos un tercio de la raíz del número. Divídase cualquier número por el cuadrado de cuatro, estráigase la raíz cuadrada del cociente y tenemos un cuarto de la raíz cuadrada del número, etc.

		3 2 1
	100	15625(100+20+5
Primer divisor probante	200	10000
" " verdadero	220	5625
Segundo " probante	240	4400
		1225
" " verdadero	235	1225

RAIZ CUBICA.

Añádase á cada verdadero divisor, segun se presenten dos veces la superficie de un lado del pequeño tubo, y uno á cada uno de los tres rectángolos para el divisor probante, porque eso hará los tres lados del cúbico entero.

Regla.—Divídase cualquier número por el cúbico de 2, extráigase la raíz cúbica del cociente, y tenemos la raíz cúbica del número. Divídase cualquier número por el cúbico de 3, ó 27, extráigase la raíz cúbica del cociente y tenemos un tercio de la raiz del número. Divídase cualquier número por el cúbico de 4, ó 64, extráigase la raíz cúbica del cociente y tenemos un cuarto de la raíz del número. Divídase cualquier número por el cubo de 5, ó 125 extráigase la raíz cúbica del cociente y tenemos un quinto de la raíz del número.

```
1728) 110592 (64
       10368
       -----
        6912
        6912
```

PARA ENCONTRAR EL NUMERO DE PIES CÚBICOS QUE CONTIENE EL BUSHEL.

Regla.—Mudase el punto decimal un lugar hácia la izquierda y multiplíquese el cociente por 8.

Ejemplo.—Dentro de un vacillo de 800.9 piés cúbicos, mudase el punto un lugar hácia la izquierda, y tenemos 80.09; multiplíquese por 8 y tenemos 640.72 el número de bushels.

N. B.—Añádase uno por cada tres cientos.

EJERCICIO MENTAL.

El número medio de dos números es la mitad de sus sumas ó el número igualmente distante de los dos números. El producto de dos números, es el cuadrado del número medio disminuido por el cuadrado de la mitad de su diferencia.

Problema.—19 por 21, 18 por 22, etc., hasta 15. Así: el número medio es 20, el cuadrado de 20 es 400, 400—el cuadrado de 1 es 399; el producto, 18 por 22 es el cuadrado de 200, 400 el cuadrado de 2, 4, 396. 17 por 23 es 391, 16 por 24, 384; 15 por 25, 375.

El complimento de un número es la diferencia de aquel número y algun otro número especial mayor. El suplemento de un númeroes la diferencia de aquel número y algun otro número especial menor.

Asi el complimento de 99 es la diferencia de 99 y 100, el cual es uno. El suplemento de 101 es la diferencia de 101 y 100, el cual es 1.

Abgekürzte neue Rechnungsmethode

des

J. A. Henderson,

und um dieselbe leicht begreiflich zu machen.

Die Maßregel derselben sind folgender Art:

1. Das numerirte Alphabet kennen zu lernen, wie folgt:

$\frac{1}{1}, \frac{2}{1}, \frac{3}{1}, \frac{4}{1}, \frac{5}{1}, \frac{6}{1}, \frac{7}{1}, \frac{8}{1}, \frac{9}{1}, \frac{0}{1}.$

2. Das stipulirte Interesse nach Methode umzudrehen, wie folgt:

3 pr. Ct. per Monat oder $\frac{3}{1}$, umgedreht $\frac{1}{3}$ Monat = 10 Tage.

3. Für das zehnfache eine Null oder Zero zu anexiren, wie folgt:

$\frac{1}{3}$ Monat × bei 10 oder $\frac{10}{3}$ Monat = 100 Tage.

4. Für den zehnten Theil eine Null (Zero) zu präfixiren, wie folgt:

$\frac{1}{3}$ Monat ÷ bei 10 oder $\frac{01}{3}$ Monat = 1 Tag.—

Die Gründe sind folgende:

Das Umdrehen der Interessen demonstrirt immer die Zeit, wenn ein Thaler ($ 1.00) einen Cent (1 ct.) macht.

Das anexiren einer Null (0) verzehnfacht die Zeit, gleich dies

1 Cent zu 10 Cents.

Das präfixiren eines Punktes oder Null (0) verkürzt die Zeit zehnfach, daher auch der Cent als eine Mille oder $\frac{1}{10}$ Cent gerechnet werden muß.

Beispiel:

3 pr. Ct. per Monat [ist×]

	3		nach dem Alphabet $\frac{3}{1}$
.	1	0	
	3		umgedreht macht es ⅓ per Monat oder 10 Tage.

1 Tag	10 Tage	100 Tage	
$ 15	0	0	0.00
9	0	0	0.00
1	2	0	0.75
1	3	6	0.25

Erklärung.

Jedermann, der daher die oben gelieferten Maßregeln gründlich gelernt hat, wird leicht ein=sehen, mit welcher Leichtigkeit diese Methode alle

Rechnungen lößt indem sie das gewöhnlich Schwierige durch Decimals angreift.

Hat man daher ausgefunden wenn $ 1.00 einen Cent macht, so wird Jedermann klar einsehen, daß er nur die Zahl der Thaler als Cents zu betrachten hat, um die Lösung derselben zu finden.

Sollte man nun wünschen auszufinden die Interessen von einer Summe zu 3 per Cent per Monat für 133 Tage, so gibt die Kenntniß dieser Methode ebenfalls eine leichte Lösung.

[Znm Beispiel] Die Interessen von $ 1.00 zu 3 per Cent per Monat:

3 per Ct. per Monat ist = $\frac{1}{3}$ Monat = 10 Tage (und macht 1 Cent in 10 Tagen) folglich für 133 Tage

für 100 Tage	das zehnfache v. 10 Tagen od.	1 Cts. =	10
„ 30 „	das 3 × „ „ 10 „ „	1 „ =	3
„ 3 „	3 mal d. 10ten Theil v. 10 T. „	1 „ =	0,3
		Cents	13,3